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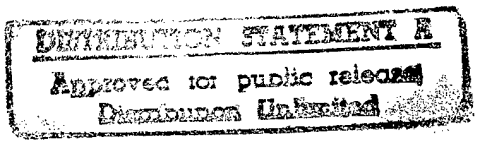

Science & Technology

Central Eurasia: Space

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Goal of New Mission to Mir to Extend Life of Station

927Q0203 Moscow NEZAVISIMAYA GAZETA in Russian 21 Jul 92 p 6

[Article by Anatoliy Zak, under the rubric "Space Program": "They Are Doing Everything They Can to Extend the Life of the Mir Station: It Must Hold on in Orbit Until 1996"]

[Text] If everything goes according to plan, on 27 July 1992, at the Baykonur launch facility (Kazakhstan), a Soyuz TM spacecraft will launch with a crew consisting of commander Anatoliy Solovyev, flight engineer Sergey Avdeyev (an NPO Energiya specialist), and French cosmonaut-researcher Michel Tognini. Tognini can hardly be considered the kind of fellow traveler who has traditionally accompanied our crews during the short shift changes in orbit in recent years. The mission of the French researcher, under the code name Antares, will last roughly a month, during which biological, medical, and physics experiments will be conducted. Tognini, by the way, was a backup for Jean-Loup Chretien for the latter's second mission into space as part of a Soviet crew. Thus, our French space partners remain the most active foreign participants in the Russian space program.

A representative of the French space agency CNES who was at the press conference reported that there would be four additional joint missions, with the next one in 1994. Tognini's current backup, Jean Pierre Haignere, may take part in one of them. Unlike previous Soviet-French flights, the forthcoming flight and all those after it will be performed on a commercial basis; that is, the client—France—pays the Russian side in hard currency for services provided (launcher, spacecraft).

The French experiments will be continued aboard the Mir station after Michel Tognini returns to the ground. The chief purpose of the mission of the main expedition, however, will be, in the words of its flight engineer, the extension of the life of the station. The cosmonauts are to conduct unprecedented operations to install, inside the station, an entire complex of gyroscopic units weighing 80 kg each. Earlier, a similar operation had been expected to be performed outside the station.

The most dramatic moments of the program of the 12th expedition to the Mir orbital station will be the four spacewalks of the crew to install a propulsion system that is to make control of the station easier. The block of engines, plus their fuel supply, will be set up on the top of the steerable 15-meter-long trusswork boom known to specialists as Sofora. That unique structure, developed at Kiev's Paton Institute, is already fitted to the outside of Mir.

The orbital station's main unit must hold on in working condition until at least 1996, when, in all probability, the Mir-2 will be launched to replace it. Mir-2 is to be placed into orbit with an inclination that is larger than those of all its predecessors. That will make it possible from the station to see the high latitudes of the globe, including the polar regions of our country, which to date are inaccessible for observation by our cosmonauts. Inasmuch as the new orbit presumes flight through more intense radiation belts, the forthcoming expedition will involve experiments associated with radiation safety. Indeed, radiation physics is the primary specialty of flight engineer Sergey Avdeyev.

According to existing plans, the new crew will stay in orbit until 20 January 1993, after which it will be replaced by its current backups, Gennadiy Manakov and Aleksandr Poleshchuk.

Biographical Notes on Crew of Soyuz TM-15

927Q0210A Moscow KRASNAYA ZVEZDA in Russian 15 Jul 92 p 4

[Article by Mikhail Rebrov, KRASNAYA ZVEZDA correspondent: "'Antares' Program at the Launching. Who is Next? The Crew of the Twelfth Mir Expedition Has Arrived at Baykonur and is Completing Prelaunching Preparations"; the first three paragraphs are an introduction]

[Text] "Antares"—such is the name assigned to the program for a joint Russian-French commercial space flight which will be launched on Sunday 26 July at 1031 hours Moscow time. Ballistic specialists do not preclude delay of the launching a day or two, depending on correction of the Mir orbit.

The two weeks of work in the orbital complex provide for a series of scientific and technological experiments and research and to some degree represent a continuation of the "Aragats" program, which was carried out in 1988.

Today we will introduce those who will be members of the international crew of the Soyuz TM-15 spaceship.

Commander. Colonel Anatoliy Solovyev is being launched into space for a third time. It turned out that the intervals between his flights fell two years apart: 1988, 1990, 1992. He was commander on the Soyuz ships in the modifications TM Nos 5 and 9; the Bulgarian citizen A. Aleksandrov and our engineer A. Balandin flew with him. Twice he emerged into open space and the total time he has spent in orbit has been more than a half-year.

The commander is excellently trained, has the credentials of a military flier first class and test pilot second class and after this launching will receive the right to be called flier-cosmonaut first class. After mastering more than ten types of jet aircraft, he surely feels himself to be a spaceship pilot, knows the Mir station and the modules docked to it in detail and has proven himself to be a literate and thoughtful researcher and acts with enviable composure in extremal and emergency situations (precisely such situations are simulated during multisided training).

Anatoliy Solovyev is 44 years old, is married and has two children.

Cosmonaut-researcher. Michel Tonini, a colonel in the French Air Force, a test pilot with a total flight experience of 3300 hours, has made 150 parachute jumps and has served in the famed "Normandie-Neman" Escadrille (its 50th anniversary will be marked this year). He first arrived in Zvezdnyy [Gorodok] in 1986 as an alternate for Jean-Louis Chretien and trained for implementing the "Aragats" program for two and a half years (a month flight with emergence into open space). He speaks frankly about his impressions of the new stage of training, emphasizing the high professionalism of the instructors at the Cosmonaut Training Center and the unique training base at Zvezdnyy.

Tonini (he is 43 years old) is a member of the group of French astronauts, but also hopes to enter the contingent of European space researchers. However, what is most important for him is the impending visit to the Mir. Moreover, he does not consider it to be his last flight because the next flight for a French representative is planned for 1994-1995. Who knows but that he may be lucky again. However, the word "lucky" is no more than an expression. Tonini has earned his right to fly by many years of stubborn striving to achieve goals and realize dreams.

I recall still another detail from Michel's biography. While he was an alternate, in 1988, at Zvezdnyy he met Yelena Chechina, a physical training instructor, fell in love, pledged his hand and heart and carried her off to France. Now they have a growing daughter.

Ship's engineer. Sergey Avdeyev, 36 years old, graduated from the Moscow Physical Engineering Institute and is a graduate student (with the intention of defending his dissertation after the flight). His military rank is first lieutenant in the reserve. His path into cosmonautics began at the Energiya Scientific Production Association where he became a test engineer.

He enrolled in the cosmonaut detachment in 1987 and was alternate ship's engineer for the 11th main expedition. The following lines are taken from his service record: "High engineering skills, profound knowledge of physics, capacity for independently executing programmed work and experimental research in combination with flights in a jet trainer and parachute jumps (he has made 35) has given Avdeyev merited authority in the group."

The alternates for the main crew are Colonel Gennadiy Makakov, Colonel Jean-Pierre Enere of the French Air Force and engineer Aleksandr Poleshchuk.

What draws them into flight? Romance, thirst for fame, money? There was romance only in the very beginning when the first steps into space were being taken. At that time all the cosmonauts were known by name, they were invited everywhere, they sat in places of honor and listened to speeches of praise. So it was then. With respect to money, the pay is nothing like many think: the salary is the same as for people on the ground and in these days is not at all high. And we also know of the decorations. Today the words of delight at their feats have been replaced by criticism directed to the leaders of space programs, and at the same time the shadow has fallen on them. But they are continuing to do their duty, thoughtfully, with self-sacrifice and conscientiousness.

But it seems to me that there is still another aspect of the nature of these people. Indeed, it also determines their specific characteristics: courage and pride. Yes, pride! And this surely is not surprising. After all, a person has the right to be proud of himself if his work involves carrying out difficult and dangerous work for realizing great plans and daring undertakings. But there is nevertheless also romance. Without romance it is impossible to live and work in space. And this despite their external reserve and even dryness. But is this really necessary? After all, a cosmonaut by virtue of his profession is destined to take risks, and this means to be courageous.

Procedures at Baykonur at Launch of Soyuz TM-15

927Q0211A Moscow NEZAVISIMAYA GAZETA in Russian 4 Aug 92 p 6

[Article by Yuriy Meshkov: "New Omens at Baykonur. Journalists Saw Them on the Eve of Launching of the Soyuz TM-15"]

[Text] France was the first Western country with which the former USSR already began joint work in the space research field in 1966. A confirmation that "the first love is the truest love" is the present-day joint work of a Russian-French crew in orbit. This is already the third flight of a French citizen on a Soyuz ship, which also is a singular record among international space launchings carried out from Baykonur. This possibly explains the arrival at the cosmodrome of an unusually large group of French newspaper, television and radio journalists.

During the prelaunching days at Baykonur there was still another group of journalists considerably exceeding in number the press representatives of France and the CIS taken together. Our colleagues from Kazakhstan scarcely fitted into two large buses and kept themselves strictly apart from the rest of the press. And on the evening of 25 July, at a prelaunching press conference of the Interstate Commission (such is the name now given to what used to be called the State Commission) they displayed the same independent attitude toward the course of events. Most of all they were interested in the reason for the absence among the "pale-faced older brothers" (as one of the members of the Kazakhstan Union of Journalists expressed himself) of representatives of the native population who would express the interests of the government of the sovereign state. Even a small skirmish broke out on this score. As a result it became clear that Toktar Aubakirov, the first Kazakh cosmonaut, now Deputy Minister of Defense of Kazakhstan, also being a member

of the Interstate Commission, the day before, due to unpostponable business, flew to Alma-Ata and had to return to Baykonur by the time of launching of the cosmonauts.

Also noteworthy is another new feature of preflight everyday life at the cosmodrome. For the first time in the entire history of national manned spaceflight the wives of the cosmonauts were invited to the launching. This occurred, so they say, at the insistence of the French cosmonaut Michel Tonini. The life companions of the cosmonauts could be present at the procedure of their donning of spacesuits, at the report of the crew to the chairman of the Interstate Commission and then together with officials and journalists could observe the moment of the Soyuz launching. I think that the physicians of the cosmonaut support group have a high opinion of this contribution to the emotional well-being of their charges during the last prelaunching hours.

According to the program the joint flight will last until 10 August. During this time the cosmonauts must carry out two technological and eight scientific experiments. It is interesting that on the days of presence of the French delegation at Baykonur there was a discussion of the matter of the participation of the cosmonauts of that country in what is now four joint flights. It also was emphasized that future commercial launchings to a greater degree must take into account the interests of Kazakhstan. As was announced to the journalists by the chairman of the Interstate Commission, Colonel General Vladimir Ivanov, commander of the space units, an interstate space council is now being established which will be made up of all CIS space agencies.

Progress M-15 Launched To Mir Space Complex

LD2710205492 Moscow ITAR-TASS in English 2018 GMT 27 Oct 92

[By ITAR-TASS]

[Text] Moscow October 27 TASS—The automatic cargo craft Progress M-15 was launched at 20:20 Moscow time [1720 GMT] on October 27, 1992, in accordance with the program of further works of the Mir scientific-research complex, the ground Mission Control Center reports.

The aim of the craft launch is to deliver (expendable) materials and various cargo to the Mir complex.

The Progress M-15 craft was put into the orbit with the following parameters:

—the maximum distance from the earth surface is 233 kilometers;

—the minimum distance from the earth surface is 194 kilometers;

—the period of rotation is 88.5 minutes;

—the inclination is 51.6 degrees.

According to the telemetric information data, the on-board systems of the automatic cargo craft are functioning normally.

Israel Said To Be No Longer Interested in Flight to Mir Station

927Q0212A Moscow LITERATURNAYA GAZETA in Russian No 31, 29 Jul 92 p 2

[Article by Andrey Filippov: "Mir Station: A Million for a Ticket; The Russian-French Space Flight Has Begun"; the first paragraph is an introduction]

[Text] "And there will be apple blossoms on Mars..."—they sang in a half-forgotten song composed at the time of universal space euphoria. At that time none of us paid attention to the millions spent on cosmonautics. Now, however, without 12 million American dollars in his pocket not a single foreign cosmonaut-researcher can be launched into space. Such is the standard price for the unoccupied third seat in the Soyuz-TM ship. But where will the cosmonaut-researchers of the CIS get such money?

The Soyuz TM-15, launched on 27 July, is today docking with the Mir complex. If, to be sure, "our system for automatic rendezvous and docking, which is unprecedented in its reliability and which in the future may become the basis for the standardization of all world docking equipment," to use the words published in NEZAVISIMAYA GAZETA, operates, as always, faultlessly. This means that in the case of difficulties, if, as happens in many cases, the on-board computer fouls up, we will shift over to manual control. When the commander looks at the docking target through a display and moves the engine thrust control lever. For the time being the numbers of automatic dockings are fewer than manned dockings, "manual" tyings of a ship up to a station. And if it is recalled how difficult things have gone with the Progress M base module (almost every second freighter is docked on the second or even a third try)? And how tortuous it has been with the "D" ("Kvant") module?

However, anyone can make a mistake. Especially in cosmonautics, where every flight is a test flight. If only in conversations about it there would be neither praise nor reproach, but only an attempt to tell the truth.

But, indeed, so it goes. The flight of the "Rodniki" [crew callsign]—A. Solovyev and S. Avdeyev—will end in January 1993. (Michel Tonini will land in the Soyuz TM-14 together with the "Vityazi" [crew callsign]—A. Viktorenko and A. Kaleri—on 10 August). But for the time being no one knows when the next launching will take place. Due to vagueness in financing it is not impossible that there may even be a lull in space flights, that is, the potentially superprofitable orbital complex may for some time be "put in mothballs."

There are no foreign cosmonauts who for 12 million American dollars want to fly for seven days in the Mir station the next time. The line of candidates has dried up. Like the Israelis wanted to fly but have changed their minds and no one else has been found. Is it possible that a poor job has been done in finding one? Because until now national cosmonautics has had no inducement to find one. All the foreign exchange is taken away by the government and it goes, as noted by B. Ostroumov, deputy general director of the Russian Space Agency, "for other needs." Since there is an empty seat in the spaceship (!) the possible flight of a national journalist is acquiring particular timeliness.

Program for Averting Asteroid Collision With Earth

927Q0213 Moscow POISK in Russian
No 26, 20-26 Jun 92 p 3

[Article by Arkadiy Sosnov, POISK correspondent, St. Petersburg, under the rubric "The World Laboratory": "So That a Stray Star Doesn't Hit: We Continue to Acquaint the POISK Readers With the Most Interesting Projects of the World Laboratory in Russia"; first paragraph is source introduction]

[Text] **What with our day-to-day worries about our daily meat and bread, we have been forgotten how to look to the future. There are fewer conversations about the global ecological crisis, the destruction of the ozone layer, the phenomena associated with the things that are coming at us from space. By the way, those phenomena—which can be very aggressive—have hit the Earth more than once already and could drop in unexpectedly at any moment.**

The famous Arizona crater that is 700 meters deep and 1.3 kilometers across is a testament to a "meeting" with a 40-meter asteroid. It's easy to imagine what the scale of the Tungussk disaster would have been if it had occurred not in Siberia, but in densely populated Western Europe. In the office of Prof. Andrey Sokolskiy, the director of the Russian Academy of Sciences Institute of Theoretical Astronomy, I saw a map of the Earth on which points at which asteroids had hit were marked. The map was like the face of somebody who had had a very bad case of acne. And there were a lot of little "pock marks" on Russia.

According to estimates of the U.S. National Aeronautics and Space Administration, the degree of risk to an individual for a collision between Earth and a large space body is comparable to the risk he is exposed to when flying on an airline. And if states and companies are concerned about flight safety, someone should be thinking about how to reduce the risk of an encounter with an asteroid.

Astronomers have a data base on large (on the order of a kilometer) asteroids that are approaching Earth. But it is more probable that asteroids 10-100 meters across would dive at us. There are hundreds of thousands of them, and most of them can't be intercepted. By the way, the average frequency with which the Earth encounters a body 50 meters across is once a century. And they're not what you could call pleasant encounters.

The fall of an asteroid 100 meters across at a velocity of 15 km/sec would be accompanied by a release of energy with a TNT equivalent of 30 megatons (nearly 1,500 Hiroshimas). In a world saturated with nuclear weapons, that represents the Apocalypse. In addition, the ejection of matter from the crater could exceed thousands of times over the volume of the falling body, and that, because of the global particulate in the atmosphere, would result in a "nuclear winter."

Disaster can be avoided only if the efforts of many countries are consolidated. When in 1972 an asteroid 10-meters across flew at an altitude of 80 km over the Canadian province of Uta, it was perceived by the missile defense systems to be an attack by Soviet missiles. That was during the Cold War. In the new political conditions, the presence of a "common enemy"—asteroids—is forcing us to join together.

In order to resist the "enemy," we need to first create an international monitoring network—that is, "connect" observatories, institutes, and tracking stations with communications systems so that information of approaching asteroids can go to one center. That all-planet headquarters would inform governments of impending disasters, would model the aftereffects, and would develop measures for joint protection.

The International Institute for Asteroid Hazards (IIAH) has already been created in St. Petersburg at the World Laboratory.

But what has to be done first? At present in the solar system, some 10,000 asteroids have been observed at least once. Of them, more than 5,000 have been described in detail and "numbered." So one of the first things to be done is to form a bank of detailed data on the orbits, sizes, and physical and chemical properties of those asteroids. Then it will be possible to predict their appearance and classify them according to degree of danger.

Asteroids are detected primarily with optical methods. But now, thanks to contacts the IIAH has made with the military, who are prepared to use their own wealth of experience for peaceful purposes, radar methods have been added. Our radars are easily capable of observing such objects.

So, let's say we are a target. How do we prevent a collision or at least minimize the damage? One way is to shatter the asteroid with a missile volley. Then, of course, instead of a large body, a swarm of small bodies will pepper down. And there are cleverer projects. Like treating the asteroid—which often is a conglomerate of ice and rock clumps embedded in it—with a powder. That changes its reflecting capacity and, along with that, its orbit. Or we could also send a space craft to the asteroid, mount a jet engine there, and, by gradually changing its orbit, take it away from Earth. It's like science fiction, isn't it? But there are techniques at today's level of technologies,too. For example, atomizing space bodies up to 100 meters across with a powerful, focused laser beam.

It's not difficult to guess that a program for controlling asteroid hazards is very expensive. The first large contribution by NASA—the set up of a unique telescope—is still ahead. And for the time being, the program is unfurling as a result of incoming sponsor monies and scientific-commercial activity, at which the IIAH has been so successful that it has already conducted a competition for grants for the Teutates project worth 5.1

million rubles. That sum is being distributed for some 20 research topics among many institutes of the CIS, including universities, academy centers, and organizations of the military-industrial complex.

Teutates—an asteroid 1-3 kilometers in diameter, discovered by French astronomers, who named it for the Gallic god of cruelty and war—will approach to within about 3 million kilometers of Earth in December of this year. That's eight times farther from the Earth than the Moon is, but by space measures it's rather close. Scientists are thinking of using the opportunity to perfect an entire system of measures that would be used on the threshold of unwanted encounters with asteroids.

The first, most prominent grant has gone to the Institute of Theoretical Astronomy, to calculate the orbit of Teutates and determine its parameters in greater detail. It is expected to be observed with various methods for the first time. Specifically, a preliminary agreement has been concluded with the general headquarters of the Combined Armed Forces of the CIS for the transfer of a number of radars from military tasking and the reoutfitting of them for observing the Gallic god.

Moscow and Kharkov scientists, together with colleagues from the Far East, will ascertain the physical properties of the asteroid.

Specialists of the Institute of High Temperatures will model an unfavorable situation: the entry of the asteroid into the atmosphere and a collision with Earth as a result of a change in orbit. There, in the laboratory of Academician Vladimir Fortov, a color computer film is being "shot" with that intriguing plot. The results of the study will suggest how to change the trajectory of the asteroid without destroying it, in order to deflect its path.

Finally, the IIAH is allocating money for the construction in the Crimea of a special telescope that will later be equipped with CCD's (charge-coupled devices) for transferring the information to computer and processing it in real time. NASA experts feel that with telescopes like that positioned at various points on the globe, plus radars, 95 percent of all asteroids larger than 0.5 kilometer and capable of sooner or later colliding with Earth can be accounted for within 20 years.

The Teutates project is designed to last one year, but it is absolutely clear that it is only a prologue to an understanding of the problem. With time, IIAH should become one of the world's information centers for the planet's safety and should be operating on a permanent basis—as a weather service and as a service for forecasting earthquakes. And it will be financed not only by sponsors, but also out of the budget, through the State Committee for Emergency Situations, since a collision between Earth and an asteroid is the same kind of emergency as a hurricane or a flood.

But here's the question: How much time do we have to prepare for an encounter with an unannounced arrival? According to the predictions of specialists, no direct threat of a collision between a space body and Earth is foreseen up to the year 2000 at least. Those at IIAH feel that we shouldn't scare people into believing that something is going to fall out of the sky on them, but the risk is real, and we shouldn't shut our eyes to it. The world has a lot to lose.

Response of Nighttime Low-Latitude Ionosphere to Reversals of B_z Component of Interplanetary Magnetic Field From Interkosmos-19 Data

927Q0206A Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 32, No 3, May-Jun 92 [manuscript submitted 19 Apr 91; resubmitted 2 Dec 91] pp 10-15

[Article by M. G. Deminov, G. F. Deminova, Institute of Terrestrial Magnetism, Ionosphere, and Radiowave Propagation, Russian Academy of Sciences; UDC 550.388.2:523.62-337]

[Abstract] Changes in the F layer of the ionosphere after an isolated reversal of the B_z component of the interplanetary magnetic field result from an additional vertical drift of plasma $W = E_\lambda \cos I/B$, which is associated with the penetration of the mid- and low-latitude ionosphere by the electric field of magnetospheric convection E (with E_λ and B representing the eastern component of the field and the geomagnetic field along the altitude of the maximum of the F layer, respectively, and I being the magnetic dip. One would expect an appreciable redistribution of N_e throughout the entire low-latitude ionosphere. Since there are not enough ground stations to confirm such an expectation, the researchers here sought to do so by using data on the nighttime low-latitude ionosphere collected by Interkosmos-19 over a two-day period in 1980 (May 21, 22), as it crossed the equator near 3.8 LT. Analysis of the data demonstrated that the electrical field associated with the B_z reversal is adequately described by a system of equations presented by the researchers. They found that a reversal from north to south leads to additional drift of the plasma downward at near- and post-midnight hours. A reversal from south to north produces a drift upwards, resulting in an increase in N_e in the outer ionosphere, with a shift in peaks of the equatorial anomaly away from the equator and an amplification of the equatorial anomaly in f_0F2. Figures 1, references 7: 6 Russian, 1 Western.

Global Magnetic-Variation Sounding of Earth From Magsat Data

927Q0206B Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 32, No 3, May-Jun 92 [manuscript submitted 29 Jul 91] pp 10-15

[Article by V. N. Orayevskiy, N. M. Rotanova, V. I. Dmitriyev, V. Yu. Semenov, T. N. Bondar, D. Yu. Abramova, Institute of Terrestrial Magnetism, Ionosphere, and Radiowave Propagation, Russian Academy of Sciences]

[Abstract] Magsat data are used to produce data containing information on the parameters of magnetic variation sounding, which are in turn used to construct a new global sounding curve. Apparent specific resistance ρ_T and phase φ_T are calculated with spherical harmonic analysis (SHA) and continuum spectrum sounding. The "daily" data tapes produced by Magsat, which measured total field and components to accuracies of 2 nT and 6 nT, respectively, contain data polled at a frequency of eight measurements per second for the total vector and 16 measurements per second for the components. The researchers here also used information on satellite position, spherical harmonic coefficients of the main magnetic field, local time LT, dip, and SHA coefficient estimates for ring-current field. Ground observatory data for the period 30 October 1979 to 11 June 1980 were used to determine magnetic activity. Analysis of the experimental values for ρ_T and φ_T suggests that the numerical values calculated from the satellite data were generally in good agreement with similar parameters obtained from ground observatories. Processing of morning Magsat data did not produce satisfactory results. The ρ_T and φ_T parameters obtained for a broad range of periods yielded results for diurnal periods that were in agreement with one another. As with ground-based magnetic-variation sounding, φ_T phases were more distorted than were ρ_T amplitudes. Figures 4, references 15: 6 Russian, 9 Western.

Empirical Model of Trapped Radiation in Magnetically Quiet Period From Interkosmos-19 Experiment Data

927Q0206C Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 32, No 3, May-Jun 92 [manuscript submitted 13 May 91; resubmitted 17 Sep 91] pp 105-108

[Article by A. A. Gusev, G. A. Glukhov, Yu. V. Mineyev, G. I. Pugacheva, Ye. D. Tolstaya, Scientific Research Institute of Nuclear Physics, Moscow State University; UDC 550.383]

[Abstract] The need for empirical models of radiation trapped at low altitudes in near-Earth space stems from the wide discrepancies that exist between model data and experimental data. The models widely used today are the AE-8, AP-8, and Gosstandart models, which are based on experimental data obtained in 1959-1973. Those three models, which are used for calculating solar-activity maximum and minimum values for periods subsequent to 1973, are inadequate because solar activity at the maximum of the 20-year cycle (1960-1980) was one and a half-two-fold lower than at the maxima for subsequent cycles. That prompted the researchers here to study the creation of a "stationary" experimental model of electrons trapped in 1979. The model uses data from an Interkosmos-19 experiment involving a semiconductor electron spectrometer. The experiment sessions used for creating the model—21-22 March, 19-20 April, and 16-17 May 1979—were chosen on the basis of geomagnetic history. During the eight days preceding the sessions, D_{st} values were no higher than 40 nT, and the average K_p index was 2+ with a spread of about +/-1. The following instrument energy ranges were used: 0.3-0.6 MeV; 0.6-0.9 MeV; 0.9-1.2 MeV; and 1.2-2.0 MeV. Experimental data for which the minimal altitude of the mirror points was 200 km or higher were screened. A comparison of the empirical model and the Gosstandart model revealed that electron intensities of the Gosstandart model for L = 1.4-1.6 and for L = 3.0 exceed the intensities of the empirical model two- to four-fold; for L = 3.2-6.6, they exceed the new model's intensities two-fold. For the gap between the radiation belts, the intensity of the trapped electron flux in the new model is five times greater than that measured in the 1960's. The researchers note that at the solar maximum, choosing an interval of measurements preceded by a geomagnetically quiet period equal to 2-3 τ (i.e., 20-30 days) was impossible, which is why the possibility cannot be excluded that elevated fluxes of electrons injected into the magnetosphere during a storm may not have reached background level. Figures 2, references 6: 2 Russian, 4 Western.

Possibility of Remote Sounding of Magnetic Configuration of Nighttime Magnetosphere

927Q0206D Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 32, No 3, May-Jun 92 [manuscript submitted 19 Apr 91; resubmitted 21 Oct 91] pp 113-118

[Article by V. A. Sergeyev, M. V. Malkov, Polar Geophysical Institute, Kola Science Center, Russian Academy of Sciences; Institute of Physics, St. Petersburg State University; UDC 550.383]

[Abstract] The work reported here involves the testing of a method developed earlier by the researchers (Sergeyev, Malkov, GEOMAGNETIZM I AERONOMIYA, 1988, Vol 28, No 6, p 649) for remote sounding of the configuration of the magnetosphere. Essentially, the method consists in a determination of the interfaces between regions with an isotropically filled loss cone and an "empty" cone (empty in the sense that fluxes in the loss cone are weak as compared with fluxes outside the cone) for each component of energetic particles inside the auroral zone. The position of the isotropy interface and the energy of the detected particles serve as input parameters for an algorithm used to analyze the magnetosphere configuration proposed earlier by the researchers. The algorithm itself involves interpretation of the interface as a projection into the ionosphere of an interface between regions with severely adiabatic and weakly nonadiabatic particle motion in the equatorial magnetosphere. The method is tested on measurements made by the NOAA-6 and -7 satellites of the pitch-angle distribution of energetic particles and simultaneous measurements made by the GOES-2 geostationary satellite. Despite a number of constraints, the researchers managed to find 76 crossings of the auroral zone by the NOAA satellites (21-30 November 1981) suitable for the

analysis. They concluded that, with regard to the geostationary orbit, the main HP and HE magnetic field components can be reconstructed with an error of around 6 nT. The 30-250 keV proton isotropy boundaries are located at the same latitudes and are spaced in a manner dictated by the magnetosphere configuration at the moment of measurement and by the mechanism of pitch-angle particle scattering in the current layer. Figures 3, references 7: 2 Russian, 5 Western.

Satellite Coronagraph for Koronas-I Satellite

927Q0209A Moscow PISMA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 18 No 6, Jun 92 (manuscript received 21 Nov 91, after revision 26 Feb 92) pp 537-540

[Article by Ja. Buzashy, L. Klostok and M. Rybansky, Measurements Institute, Slovak Academy of Sciences, Bratislava, Czechoslovakia; Astronomical Institute, Slovak Academy of Sciences, Tatraska Lomnitsa, Czechoslovakia; UDC 520.24

[Abstract] Two institutes of the Slovak Academy of Sciences have completed work on preparation of a satellite coronagraph for the "Koronas-I" satellite. This instrument is included in the "Terek" instrument complex together with an X-ray telescope and telescope for observations in the far-UV. The coronagraph will give a corona image in white light in different time operation modes. The range of corona observation is from 2.2 to 10.0 solar radii. The described instrument draws on the designs proposed by G. Newkirk Jr., et al. in APPL. OPT., Vol 2, p 131, 1963 and S. Koutchmy in SPACE SCI. REV., Vol 47, p. 95, 1988 and the coronagraph developed for the "Soho" space experiment. An optical diagram of the instrument is shown and the functioning of individual components is described. One group of problems to be studied includes heating of the corona, escape of matter in coronal rays and its relationship to photospheric activity. Another group of problems includes the relationship between coronal rays and high-velocity flows of the solar wind and determination of conditions for the appearance of transients. Plans call for routine monitoring of circumsolar space for studying the development of coronal rays and coronal transients. Figure 1; references: 4 Russian.

Stability and Inherent Precision of Two Methods of Solving Equations of Motion and Ablation for Fireball-Forming Bodies in Earth's Atmosphere

927Q0218A Kiev KINEMATIKA I FIZIKA NEBESNYKH TEL in Russian Vol 8, No 3 May-June 92 [manuscript received 2 Dec 91] pp 69-77

[Article by V. V. Kalenichenko, Astronomical Observatory, Kiev University imeni T. G. Shevchenko]

[Abstract] Since fireballs of the Prairie network were first observed, their analysis and interpretation have formed the basis of most of the theoretical research associated with the physics of fireballs. The incorrectness of inverse-problem formulation in such research, however, has led to conclusions about the structure and nature of fireball-forming bodies that are often conflicting. McCrosky and Ceplecha have suggested using end height to classify fireball-forming bodies, but that criterion is inadequate because of the ambiguity attending its interpretation. The main error associated with the study of fireballs via inverse-problem methods is the incorrect absolute calibration of the scale of masses. An additional ambiguity stems from the absence of data on inherent precision of solution. Absolute calibration is based on use of the fireball mass, determined photometrically. Photometric mass, however, is unsuitable for fireball analysis inasmuch as the conditions attending the processes of the interaction of the atmosphere and cosmic bodies entering it are different for fireballs and meteors. In an effort to examine two methods for solving equations of motion and ablation for fire balls that would be free of the above problems, the researchers here found the method of local ballistic approximation to be more stable, fast, and universal than any method involving precise numerical solution. The ratio of initial velocity to ending velocity on a visible trajectory is found to be a reliable criterion in determining the suitability of the fireball for ascertaining the physical parameters of the cosmic body that generated it. The optimum value of that parameter can characterize the quality of the fireball catalog, with the quality being higher the closer the ratio of initial to ending velocity is to unity. Figures 3, references 12: 4 Russian, 8 Western.

Empirical Image Motion Spectrum. 1. Quality of Astroclimate and Atmospheric Constraint on Accuracy of Meridional Observations

927Q0218B Kiev KINEMATIKA I FIZIKA NEBESNYKH TEL in Russian Vol 8, No 3 May-June 92 [manuscript received 20 Jul 91] pp 78-91

[Article by P. F. Lazorenko, Main Astronomical Observatory, Ukrainian Academy of Sciences, Kiev]

[Abstract] The efficiency of the operation of astronomy telescopes depends a great deal on the astroclimate at the location of the telescope, i.e., on the quality of the star images (diameter d) and, for astrometric instruments, the amplitude of image motions σ. When a location is being chosen for an instrument, d and σ are usually evaluated by an expeditionary team with small telescopes and various calibrated instruments. Correct prediction of image quality, however, is possible only for a large telescope that is identical to the instrument used in the calibration. The researcher here set out to solve two fundamental, interrelated problems: to substantiate empirical image motion spectra and to find an analytical link between the image motion characteristics of d, σ, telescope aperture D, and a group of frequency parameters such as light detector inertia time and star observation duration. A spectral density model $G(f)=c^2f^1$ was substantiated for $f < 10$ Hz. The model presents observable properties of star image motions more accurately

than does the theoretical model for the Kolmogorov turbulence spectrum or the Hog model. The model is in agreement with current notions on the turbulence spectrum and with experimental data on velocity and temperature. Figures 4, references 24: 22 Russian, 2 Western.

Method of Position Observations of Fast-Moving Asteroids and Experience in Its Use

927Q0218C Kiev KINEMATIKA I FIZIKA NEBESNYKH TEL in Russian Vol 8, No 3 May-June 92 pp 97-99

[Article by M. R. Nesteruk, Main Astronomical Observatory, Ukrainian Academy of Sciences, Kiev]

[Abstract] At present, the coordinates of asteroids with motions that are highly visible relative to the stars cannot be ascertained with a high degree of accuracy. There are three-five times more errors in the measurement of photographic images than in the measurement of point images . Moreover, most fast-moving asteroids are not very bright, and as a result of the distribution of photons about an area that exceeds the area of the diffraction scattering circle, they cannot be photographed. This paper discusses a method of position observation of asteroids with a visible velocity of $v \geq 0.01$"/s, which makes it possible to produce point images of stars and a point image of the asteroid on an astronegative. The method was used on a complex of equipment used at the Main Astronomical Observatory and created for observing high-orbit satellites. The process involves five steps: plate, asteroid exposition, plate movement, star exposition, plate movement. Seven images of the asteroid 1036 Ganymede were made as it approached Earth in 1989. The astronomer was able to ascertain the asteroid's coordinates with an accuracy of 0.6-1.3", an accuracy one and a half times greater than that of present-day observations. References 6 (Russian).

Synthesis of Invariant System for Controlling Descent in Disturbed Atmosphere by Use of Successive Optimization Algorithm

927Q0226A Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 30, No 3, May-Jun 92 [manuscript submitted 22 Nov 90] pp 305-311

[Article by S. A. Kabanov, A. S. Shalygin; UDC 531.13: 521.154]

[Abstract] The trajectory of a lander in an atmosphere is a complex three-dimensional curve that must satisfy a whole array of constraints and must bring the lander to a given terminal state. An important problem involves landing with small trajectory inclination angles near the surface of the planet. Two-channel invariant systems provide a high degree of accuracy in the solution of that terminal problem because they have the properties of combined control. In effecting invariant control systems, however, disturbances must be measured, which is rather difficult. But in problems involving control of motion of the lander's center of mass, instead of measuring variations of the density of the atmosphere, one can measure wind-velocity values. This paper presents a solution of the terminal problem of control on a finite trajectory segment, with the lander brought to a given point with a small trajectory inclination angle in windy conditions. The solution algorithm consists in the following: the control vector U_1 optimal for the criterion I_1 is found for the time interval (t, t_p) [t_p being the predicted moment of the end of the control process]. For the same initial conditions and the same interval, the predictive model equations are integrated in forward time on the basis of the solution found for the first stage of the algorithm. Boundary values are then calculated. For the time interval (t_p, t), the equations for the predictive model and the coupled system are integrated in reverse time. The desired degree of control is found, i.e., control that is constant on the next cycle of system control, after which the solution is repeated. Figures 1, references 13 (Russian)

Thermomechanical Phenomena in Motion Relative to Center of Mass of Sun-Stabilized Spacecraft

927Q0226B Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 30, No 3 May-Jun 92 [manuscript submitted 26 Feb 91] pp 312-320

[Article by A. Yu. Kogan, T. S. Kirsanova; UDC 629.191]

[Abstract] The generally accepted model for the interaction of light flux and a solid allows for only the pressure of the incident and reflected radiation. Meantime, the energy absorbed by a spacecraft is re-emitted in the form of heat energy. From the law of conservation of energy and the relativistic correlation between photon energy and pulse, it follows that the pulse carrying the thermal energy away is equal to the pulse of the absorbed energy. Which means that the effect of the re-emission cannot be considered negligibly small *a priori.* Unlike scattered photons, thermal photons generally leave the body not at the time or where they were absorbed—a phenomenon that results in a host of new effects not considered by the current models. Describing the release of thermal photons generally requires a complex mathematical model that includes a thermal conductivity equation with boundary conditions in the form of nonlinear differential equations of motion and finite correlations expressing the Stefan-Boltzmann law. However, for a case in which an axisymmetric solar stabilizer made of thin film is used, the researchers here produced a simple asymptotic description of the motion that does not use equations in partial derivatives. Dynamic equations are used in a study of several types of trajectories and their stabilities. The researchers show that equilibria that are stable in a conservative approximation and stationary rotations can lose stability or, conversely, strengthen it to the asymptotic, depending on the correlation of the optical and thermophysical characteristics of the film. The time constant of the thermomechanical damping of

nutational oscillations is calculated for the REGATTA space vehicle. The constant is one and a half-three days, which is severalfold smaller than the typical damping time due to elastoplastic deformations of structural elements. Figures 2, references 6 (Russian).

Optimal Injection of Space Vehicle From Lunar Surface to Given Point of Artificial Satellite Circular Orbit

927Q0226C Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian V ol 30, No 3 May-Jun 92 [manuscript submitted 5 Nov 91] pp 321-332

[Article by K. G. Grigoryev, Ye. V. Zapletina, M. P. Zapletin; UDC 629.195.3]

[Abstract] In previous work on the optimal injection of a spacecraft into a circular orbit from the Moon's surface (Grigoryev et al., KOSMICHESKIYE ISSLEDOVANIYA, 1991, Vol 29, No 5, p 695), the researchers minimized the time expenditures and the compromise functional of time/mass. The spacecraft was injected in the plane of orbit of an artificial lunar satellite with control effected of the thrust vector of a high-thrust jet, and the Moon's gravitational field was considered to be a central Newtonian field. The time and point of orbital injection were not fixed beforehand. The researchers analyzed the effect produced on optimal trajectory by thrust-to-weight ratio, specific thrust, altitude of orbital injection, and compromise coefficients. Problems were solved numerically in a polar system of coordinates based on the maximum principle. Shooting was used to solve the boundary problems of the maximum principle. The work reported here—essentially, a continuation of the earlier work—involved analysis of the numerical solution, again using the maximum principle, of three types of problems associated with the optimal injection of a spacecraft: rapid injection, injection with a minimal expenditure of mass, and injection representing a compromise between the expenditures of time and mass. Optimal trajectories are calculated for a broad range of orbital-injection altitudes, as well as the other factors affecting trajectory. Figures 9, references 12 (Russian).

Flights to Asteroids From Artificial Earth Satellite Orbit With Perturbation-Aerodynamic-Impulse Maneuver Near Mars

927Q0226D Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 30, No 3, May-Jun 92 [manuscript submitted 4 Jun 90] pp 333-342

[Article by L. B. Livanov; UDC 629.197.2]

[Abstract] In the profile examined here, the spacecraft departs low-Earth orbit into a trans-Mars trajectory. Upon approaching Mars, the craft descends and performs the first half of the perturbation maneuver. Flying in the Martian atmosphere, the craft then brakes and has a constant lift /drag ratio of under 2.4. Certain dates between 1970 and 2020 for leaving Mars may require a velocity impulse upon exit from the atmosphere of up to 2 km/s. Optimal dates will have to be chosen for the Earth-to-Mars leg and the Mars-to-asteroid leg. The asteroids considered here are Ceres, Vesta, Flora, Massalia, Thule, and Trojan Odysseus. As the spacecraft ascends, it performs the second half of the perturbation maneuver. As the spacecraft approaches the target asteroid, the velocities of the spacecraft and the asteroid are equalized via impulse. The sum of the three impulses in this profile is 2-3 km/s less than the sum of the two impulses needed for direct flights to asteroids. Figures 4, references 9: 7 Russian, 2 Western.

Stratification of Barium Clouds in Ionosphere As Determined by Television Observations

927Q0226E Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 30, No 3 May-Jun 92 [manuscript submitted 26 Feb 91] pp 343-350

[Article by A. M. Yevtushevskiy, G. P. Milinevskiy, Yu. A. Romanovskiy, V. A. Savchenko; UDC 551.510.535]

[Abstract] Researchers here discuss the results of observations made in four experiments involving barium vapor injections performed in 1988-1990 at altitudes of 150-200 km over the Volgograd rocket probe testing grounds. Optical studies of the development of stratification of the ionized component of the artificial luminescent clouds wer e performed with highly sensitive television, electrophotometric, and photographic equipment located at two ground points. The equipment, with a spatial resolution of 50 m and a time resolution of 0.2 s, revealed the parameters and dynamics of the stratification and enabled the reconstruction of the spatial orientation and movement of the strata. The system of strata was found to be a combination of thin plasma filaments stretching along geomagnetic force lines and coinciding with them within roughly 1°. The strata were 100-200 m across and 20-25 km in length. Ion concentrations ranged from 5×10^5 cm^{-3} to 10^6 and was considerably greater than background, but not so much that the external electrical field within the ion cloud compensated for the disturbed electrical field. The evolution of the ion clouds, which didn't always involve stratification, can be interpreted as intermediate nonlinearity. The velocity of motion of the strata varied widely, a function of brightness and location in the stratified ion structure. Formation of new strata took place within three-four s, and the lifetime of individual strata was approximately 30 s. Stratification started at the forward edge of the ion cluster, with the departure of the strata in the direction of the drift of the cluster in the crossed E x B fields. Figures 4, references 20: 14 Russian, 6 Western.

Disturbances in Ionosphere During Trigger Effects in Active Experiments in Near-Earth Space

927Q0226F Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 30, No 3 May-Jun 92 [manuscript submitted 17 Apr 91] pp 351-356

[Article by N. V. Yeliseyev, N. V. Smirnova, S. I. Kozlov; UDC 551.510.536]

[Abstract] Active experiments at altitudes above 100 km in the auroral and mid-latitude ionosphere have revealed a considerable increase in the fluxes of precipitating electrons ranging in energy from kiloelectronvolts to tens of kiloelectronvolts. The phenomenon, which is called the trigger effect, has been observed for various types of active experiment, all of which have a common feature, i.e., the appearance in the upper atmosphere of an ionized formation and a corresponding growth in the conductivity of the medium. The disturbances associated with trigger effects may also occur in regions far from the site of the experiment itself. Researchers here performed a theoretical study of such disturbances, based on 11 active experiments that took place between 23 March 1968 and 6 October 1978. The experiments involved four locations—66.2° N, 67.9° N, 48.7° N, and 49.3° N—at altitudes of 100-380 km. Theoretical profiles of electron concentration $N_e(h)$ and $NO^+(h)$ were found to be in good agreement with those produced in the experiments. The same was true for the intensities of optically resolved emissions $N_2(C^3\Pi_u$ and N_2^+). Figures 4, references 16: 5 Russian, 11 Western.

Observations of Subauroral Nonthermal Continuum by Prognoz-10 Satellite Outside Earth's Magnetosphere

927Q0226G Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 30, No 3 May-Jun 92 [manuscript submitted 13 Dec 90] pp 357-367

[Article by V. N. Kurilchik, V. P. Grigoryev, A. Tirpak, S. V. Mironov, L. Fisher, A. Yaroshevich; UDC 581.521.6]

[Abstract] Results are presented from observations of the subauroral continuum on the distant segment of the Prognoz-10 orbit outside the Earth's magnetosphere. The researchers sought to clarify the nature of the direction parameters of the radiation. The apogee of Prognoz-10 is located at a geographic latitude of 45°, and the maximum distance from the Earth is approximately 32 R_E, which means that the nonthermal continuum on the distant segment can be observed from the northern subpolar region only. At 2-12 R_E, the continuum was recorded on 13 August 1985. Regular observations of the continuum at 1486 kHz on the distant segment began a month later. More than 40 satellite/ continuum intersections were recorded between 14-15 September and early November, between 0500 hours LT and 0900 hours LT. The researchers found that in the northern hemisphere, the radiation of the subauroral nonthermal continuum was in the form of directed rays. The appearance of continuum rays at 1486 kHz is governed by the rotation of the Earth's magnetic dipole. They appear as the magnetic pole moves into the nighttime hemisphere. The rays can be broken down into narrow, low-latitude (or equatorial) rays and broader, scattered rays propagating along the latitude of the main ionospheric trough. The geomagnetic latitude of the propagation of the equatorial rays is governed by the level of geomagnetic activity. Geomagnetic activity also affects the radiation intensity and the boundaries of the longitudinal dimensions of the region in which the radiation is generated. The equatorial rays vary in width from 0.4° to 2-3°. Scattered rays were 5-10° in width. The rays of the continuum were pulsed, lasting several tens of seconds. In the narrow equatorial rays, pulses reached the same level of intensity (10^{-17} W/m^2/Hz) that is typical for the subauroral continuum observed near the Earth. Figures 4, references 7: 2 Russian, 5 Western.

Proton Energy Spectrum Features and Problem of Origin of Cosmic Rays

927Q0226H Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 30, No 3 May-Jun 92 [manuscript submitted 3 Jan 92] pp 378-384

[Article by N. L. Grigorov; UDC 523.165]

[Abstract] The researcher in the report presented here discusses the anomaly in the proton spectrum of cosmic rays at 1-10 TeV and the discovery of high-energy ions that could come from a nearby cosmic ray source. Direct measurements of the proton spectrum made by the Proton satellite have revealed that in the range of 10^{10}-10^{12} eV, the spectrum has an exponential nature, with an exponent of $\gamma = 2.6$, i.e., the same as do all nucleons with $z \geq 2$. In the 1-10 TeV range, however, the exponent grows to $\gamma = 3.2$-3.3. The researcher suggests that the difference between proton spectra and those of other nucleons may stem from the fact that the observed flux of protons may come from sources that are different from those of the other nucleons. If those other, proton sources are of a large number, then the process of averaging the individual spectra would smooth the resulting spectrum. For that reason, the researchers feels that there are very few proton sources or, possibly, only one, which would be very near the Sun. In searching for evidence to support the hypothesis of a source near the Sun, he points to the existence of ions in cosmic rays and to studies of cosmogenic isotopes ^{10}Be and ^{14}C. The studies produce convincing evidence that 30,000-40,000 years ago, the intensity of cosmic rays was one and a half-two times greater than it is now, possibly because a supernova exploded 6 parsecs from the Sun at that time. Figures 4, references 22: 12 Russian, 10 Western.

Wave Signal Propagation Near Interkosmos-19 Satellite

927Q0226I Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 30, No 3 May-Jun 92 [manuscript submitted 21 Feb 91] pp 385-389

[Article by N. I. Izhovkina, V. I. Larkina; UDC 550.385.37]

[Abstract] The data are presented for wave signal measurements performed aboard the Interkosmos-19 satellite during the operation of the onboard ionospheric probe. The sounding of the ionosphere was done from above, and the electrical and magnetic components of the wave field were measured at several frequencies (f = 140, 450, 800, 4650, and 15,000 Hz). During the sounding, regular signals appeared on all those frequencies; for frequencies 140, 450, and 800 Hz, the period of signal variation for the electrical component was roughly twice the period of the signal for the magnetic component. The period of the recorded signals for the electrical component was the same for all frequencies; for the two higher frequencies, the periods for the electrical and magnetic components coincided with each other. The researchers here use the results of analysis to assess the influence of plasma inhomogeneities on wave signal propagation. They hypothesize that additional signals recorded for the magnetic component of wave disturbances on the three lower frequencies when the ionospheric probe was switched on may have been caused by polarization currents associated with the propagation of waves emitted by the ionospheric probe in inhomogeneous plasma. Figures 1, references 5: 3 Russian, 2 Western.

Analytical Assessment of Accuracy Associated With Determining Satellite Trajectories From Space Stations

927Q0226J Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 30, No 3 May-Jun 92 [manuscript submitted 6 Apr 90] pp 420-422

[Article by V. V. Smirnov, A. D. Golyakov; UDC 629.78]

[Abstract] In terms of satellite navigation, space stations have an advantage over ground stations in that the former have broader visibility than do the latter. But computer-based mathematical models of the accuracy attending the determination of satellite orbits from space stations do not identify the general accuracy-related patterns of the navigation process and do not produce assessments of errors associated with navigational determinations for various measurement combinations. In a theoretical study of the accuracy of determination of satellite trajectories from space stations, the researchers here use covariational matrices, with the primary navigational measurements being the distance between the space station and the satellite, the rate of change of that distance, and the angle between a line running from the space station to the satellite and a line running from the space station and a navigational star. The duration of the navigation session is assumed to be equal to one orbit, the covariational matrix of the measurement error is diagonal, and the satellite moves according to the law $\mathbf{Q}(t) = \mathbf{Q}_0(t)+\mathbf{B}(t,t_0)\mathbf{q}(t_0)$, where $\mathbf{Q}(t)$ and $\mathbf{Q}_0(t)$ are the vectors of the true and reference orbits of the satellite at an arbitrary moment in time t, $\mathbf{B}(t, t_0)$ is the matrix of the ballistics derivatives, and $\mathbf{q}(t_0)$ is the vector of the deviations of the true orbit of the satellite relative to the reference orbit at the initial point in time t_0. A cylindrical system of coordinate s is used, and the reference orbit and the orbit of the space station are assumed to be circular. In addition, the radii of the two orbits are assumed to be equal. References 4 (Russian).

X-Ray Pulsar Twins 1E1145.1-6141 and 2S1145-619 Based on Observational Data Obtained With ART-P Telescope in 'Granat' Observatory

927Q0228A Moscow PISMA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 18 No 7, Jul 92 (manuscript received 16 Mar 92) pp 570-578

[Article by S. A. Grebenev, M. N. Pavlinskiy and R. A. Syunyayev, Space Research Institute, Russian Academy of Sciences, Moscow; UDC 524.354.4]

[Abstract] Only one of the pair of X-ray pulsar twins 2S1145-619 and 1E1145.1-6141, situated at an angular distance less than 15 minutes from one another and having close periods of their pulsations (292 and 297 s respectively), was discovered on the images obtained by the ART-P telescope aboard the "Granat" observatory in the course of observations of this field on 6-7 February 1992. The 6-20 keV radiation flux from the registered source 1E1145.1-6141 was 23+/-3 milliCrab and it pulsated with a period 296.79+/-0.09 s. Data from the ART-P telescope are affording the first possibility for detailed research on this pulsar since the time of the observations made with the "Einstein" observatory because the other source in this same field, 2S1145-619, is usually much brighter than its twin and standard collimated X-radiation instruments do not make it possible to observe these sources separately. The upper limit at the level of three standard deviations for the radiation flux from the second source was 8 milliCrab in the energy range 6-20 keV. One figure is an X-radiation map measuring 3° x 3° showing the position of the twins; another figure shows the change in the period of pulsations of the flux of X-radiation of IE1145.1-6141 during the entire observation period. Figures 4; references: 10 Western.

Observations of Vela X-1 X-Ray Pulsar by 'Pulsar X-2' Instrument of 'Gamma' Module

927Q0228B Moscow PISMA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 18 No 7, Jul 92 (manuscript received 28 Feb 92) pp 579-582

[Article by V. M. Loznikov, Ye. Ye. Konorkina and A. S. Melioranskiy, Space Research Institute, Russian Academy of Sciences, Moscow; UDC 524.354.4]

[Abstract] Observations made with the "Pulsar X-2" instrument carried aboard the "Gamma" module were

made in almost every case when the gamma telescope was pointed at the pulsar Vela X-2. In such cases the source Vela X-1 fell in the field of view of one or two of the four identical instrument detectors. In studying Vela-1 an analysis was made of data from those orbits in which the source was best visible. A table lists 12 such observations: the first column gives the number of the observation, the second and third columns—the Gregorian and Julian dates, the fourth column—the time of observation and the fifth—the Doppler lag between the source and the barycenter of the binary system. The analysis was made using data for detector 2, having the best aspect relative to the source. Data with the minimum background (in the region of the geomagnetic equator) were selected. These data revealed a continuation of slowing of rotation of this X-ray pulsar. A period P = 283.24(87+/-31) s was found for JD 22448368.657448. Data registered over the course of three days of observations (beginning on 22 April 1991) for 12 orbits with the greatest source intensity and a duration about 20 minutes each were analyzed. The mean profiles of pulsar impulses are given for four energy ranges. Figures 2; references 6: 2 Russian, 4 Western.

Analysis of Sudden Impulse Profile Variations of Vela X-1 X-Ray Pulsar

927Q0228C Moscow PISMA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 18 No 7, Jul 92 (manuscript received 28 Feb 92) pp 583-587

[Article by V. M. Loznikov, Ye. Ye. Konorkina and A. S. Melioranskiy, Space Research Institute, Russian Academy of Sciences, Moscow; UDC 524.354.4]

[Abstract] This is a continuation of a time analysis of the X-ray pulsar Vela X-1 initiated earlier by the author (PISMA V ASTRON. ZHURN., Vol 18, No 7, p 579, 1992). A model of the angular frequency of rotation of a neutron star proposed by J. E. Deeter (ASTROPHYS. J., Vol 337, p 376, 1989) describes well the behavior of fluctuations of the period of pulsations of X-radiation on a time scale greater than four days and it is postulated that at a lesser time scale this effect is suppressed by fluctuations in the shape of the impulse. This model and conclusion were tested against observational data for Vela X-1. In contrast to the Deeter study, three-day pulsations were investigated. An analysis of the instantaneous profiles of impulses of the Vela X-1 pulsar obtained in 12 observations with a duration of about 20 minutes each was made using data from the "Pulsar X-2" instrument in the "Gamma Module." These data revealed a correlation between the intensity of the flux of the modulated component and the particular phase of the global minimum of the impulse profile. Such a behavior can be interpreted as transitions from accretion predominantly onto one magnetic pole of a neutron star to accretion predominantly onto the other pole with a change in the accretion rate. However, there is still no finalized physical model which can explain the observed phenomena. Figures 2; references 3: 1 Russian, 2 Western.

Hard X-Radiation Periodic Sources in Hour Range of Periods Near Galactic Center Based on 'Prognoz-9' Satellite Data

927Q0228D Moscow PISMA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 18 No 7, Jul 92 (manuscript received 20 Jan 92) pp 588-597

[Article by M. I. Kudryavtsev and S. I. Svertilov, Nuclear Physics Scientific Research Institute, Moscow State University; UDC 520.6;524.35]

[Abstract] In the course of the X-ray experiment on the high-apogee (720 000 km) "Prognoz-9" satellite virtually continuous observations were made of the neighborhood of the Galactic center. As a result of application of the "superposition of epochs" method for time series of counting rates (averaged for 10 minutes) in the energy range 10-50 keV it was possible to obtain the frequency spectra of variations of X-ray fluxes in which earlier unknown periods in the hour range 13, 9.4, 3.3, 1.96 and 1.078 hours are traced. Since most of the new periodic processes in this range were observed during instrument orientation to the neighborhood of the Galactic center it can be concluded that they are associated with sources situated in the Galactic bulge or in adjacent regions (it is known that the X-ray sources in the Galactic bulge are for the most part low-mass binaries). It is therefore postulated that the new periodic processes in the hour range of periods are associated with such low-mass binaries. These periods are orbital, although the shortest of them (1.96 and 1.078 hours) may be attributable to the rotation of a compact object. The discovery of new periodic processes in this experiment became possible due to conditions ensuring continuous observation of each source for a prolonged time, up to tens of days. Figures 2; references 21: 3 Russian, 18 Western.

Periodic Errors in Star Abscissas in Hipparcos Experiment Caused by Oscillations of Basic Angle

927Q0228E Moscow PISMA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 18 No 7, Jul 92 (manuscript received 16 Jan 92) pp 630-637

[Article by V. V. Makarov; Main Astronomical Observatory, Russian Academy of Sciences, St. Petersburg; UDC 520.6;524.3]

[Abstract] The space astrometry experiment Hipparcos, now being implemented, is intended for constructing a highly accurate coordinate system of 120 000 stars distributed throughout the sky with a mean position accuracy of 2 mlsec of arc. The first attempt at organizing a catalogue of positions and parallaxes of 20,000 stars (L. Lindegren, et al., ASTRON. AND ASTROPHYS., 1991 (in press) revealed the presence of errors in the abscissas of stars, hypothetically of a systematic character. Exploring this matter further, using the most general scheme for the processing of observations, a study was made of the problem of reducing the errors in star abscissas caused by changes

in the magnitude of the basic (measuring) angle within one rotation of the Hipparcos satellite. Such changes may be manifested due to systematic variations in the heat flow from solar radiation in the structure of the Hipparcos satellite, not having axial symmetry and enclosed in a hexahedral hull. It is shown that the most dangerous oscillations are those with a wavelength 60°. An approach is proposed which would result in a decrease in the possible periodic errors when using two different basic angles aboard an astrometric satellite in the second epoch of observations, plans for which are now under discussion. Figures 2; references: 3 Russian.

Galileo Spacecraft Flyby of Gaspra Asteroid

927Q0219A Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 26, No 3 [manuscript received 13 Jan 92] May-June 92 pp 3-7

[Article by A. T. Bazilevskiy, Institute of Geochemistry and Analytical Chemistry imeni V. I. Vernadskiy, Russian Academy of Sciences]

[Abstract] For the moment, only individual images of the asteroid Gaspra are being transmitted to Earth by Galileo, because a directional antenna aboard the probe failed to open completely. This paper presents an image of Gaspra released and disseminated by JPL. Its author reports on the conditions of the flyby and shares the thoughts evoked in his mind as he examines the image. The probe rendezvoused with the asteroid when Gaspra was 410 million kilometers from the Sun and 330 million kilometers from the Earth. The angle between the flight path of the probe and the direction to the Sun was 33 degrees, and Gallileo was approaching the asteroid at a speed of 8 km/s. Because the asteroid's orbit was determined to within only 50 km, the television camera looked at a space much broader than the expected position of Gaspra. Gaspra has rounded, angular features, much the same as Mars's satellites Phobos and Deimos, and that represents a typical fragmentation form. The size of the illuminated portion of the image is 12 x 16 km. The smallest of the distinguishable craters on the image is 300 m in diameter. Craters with diameters of 1 and 2 km are visible. Typical of the Gaspra surface are smoothed depressions several kilometers across, possibly old impact craters or surfaces where a larger body split off. The pronounced cracks of Phobos are not visible on Gaspra. The visible face of Gaspra contains somewhat more craters per unit area than do the lunar maria, whose basalt plains were formed 3-4 billion years ago. The probability of collisions with crater-forming bodies, however, is markedly greater in the asteroid belt than in the vicinity of Earth and the Moon. The lower force of gravity on Gaspra results in the formation of larger craters than on the Moon. The age of the surface of the visible faces of Gaspra is believed to be 200 million years. The resolution of the Galileo image is not good enough to ascertain whether Gaspra has a covering of regolith, a determination that is important for the correct interpretation of the reflectance spectras of the asteroid. Figures 3, references 5 (Western).

Classifying Lunar Disk in Terms of Albedo, Color Index, and Degree of Polarization. First Quarter.

927Q0219B Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 26, No 3 May-June 92 [manuscript received 24 Jun 92; resubmitted after correction 28 Jan 92] pp 14-25

[Article by O. I. Kvaratskheliya, V. V. Novikov, Kh. G. Tadzhidinov, State Astronomy Institute imeni P. K. Shternberg]

[Abstract] A three-parameter optical classification of the lunar disk—based on albedo, color index, and degree of polarization, which are parameters that characterize the properties of the lunar regolith—is undertaken on the basis of images of the eastern part of the lunar disk that were made 15 January 1989 with a Zeiss-600 telescope equipped with a glass light filter and polaroid, at an effective wavelength of 450 nm. Images made in the red region of the spectrum at 650 nm and a phase angle of 67 degrees were also used. The researchers were guided by the postulate that the principal factor affecting the formation of reflected lunar light consists of the chemical composition and mineralogical inhomogeneities of the regolith. Porosity and degree of fragmentation of the regolith were regarded as secondary factors. Representativeness in terms of optical parameters was studied for seven landing sites—Apollo-11, -15, -16, and -17, and Luna-16, -20, and -24. Total visualization found the sites for Apollo-15 and -17 to be the most representative sites on the eastern part of the disk. Figures 3, references 17: 14 Russian, 3 Western.

Structures of Gravitational Spreading in Maxwell Montes on Venus

927Q0219C Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 26, No 3 May-June 92 [manuscript received 6 Jan 92; resubmitted after correction 21 Jan 92] pp 26-43

[Article by A. A. Pronin, M. A. Kreslavskiy, Institute Geochemistry and Analytical C hemistry imeni V. I. Vernadskiy]

[Abstract] The surface structures of the Maxwell Montes on Venus are interpreted from the standpoint of gravitational tectonics. The researchers chose an approach that combines observations of surface structures and modeling results, which enables a comparison of data obtained independently. The choice of the approach was closely tied to the choice of area to be studied. Maxwell Montes represents one of the highest uplands of Venus, rising six or seven kilometers from foothills to summit. The researchers identified a pattern of change among zones of compression and extension whose locations correlate with altitudes. That suggests that gravitational potential affects the distribution of such zones, which provides a basis to apply a numerical model in which the behavior of the mountain rock is described by the movement of a very viscous incompressible fluid in the field of the force of gravity. Comparison of the results of morphological analysis and modeling show that they are in good agreement. Since Maxwell Montes is some 10 km above surrounding plains, and the possible difference in the densities of crustal and mantle materials is about 10 percent, one could expect, in the context of equilibrium isostasis, that the thickness of the crust is about 100 km. Figures 16, references 13: 5 Russian, 8 Western.

Coagulation Model of Middle-Atmosphere Aerosols. Optimization of Influx of Cosmic Dust

927Q0219D Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 26, No 3 May-June 92 [manuscript received 26 Jun 91] pp 53-60

[Article by V. N. Lebedinets, O. Kurbanmuradov, Physico-Technical Institute, Turkmen Academy of Sciences]

[Abstract] An algorithm developed earlier by the researchers here for calculating the concentration of aerosols from space at altitudes of 30-110 km was based on the condensation of vapors of meteoric matter, the coagulation of aerosols and micrometeorites, diffusion, and sedimentation. Numerical calculations put the total influx of cosmic dust into the atmosphere ($\gamma\gamma\mu$) a t 40 t/day and enabled the postulation of a physical mechanism for the formation of the light-scattering layer in the upper stratosphere that is being detected with optical probing. The values calculated for the coefficient of aerosol light-scattering (δ_a) for the entire middle atmosphere, however, are approximately one and a half-fold lower than those of observations, and the altitude of the light-scattering layer in the upper stratosphere is lower by 15-20 km. Those discrepancies are explained by the lower figure for the influx of cosmic dust: at $\gamma\gamma\mu$ = 40 t/day, the discrepancy can be eliminated by any alterations in the relative distribution of aerosol mass or altitude profile of the coefficient of turbulent diffusion. In this paper, the researchers evaluated the effect of mean aerosol density and mean micrometeorite density (δ) on the light-scattering characteristics of the middle atmosphere and optimized $\gamma\gamma\mu$ and δ from the standpoint of a situation in which the calculated altitude variation of the coefficient of aerosol light-scattering agrees with the observed variation. They found that the observed altitude profile of (δ_a) in the middle atmosphere at altitudes of 30-80 km is rather well described by a condensation-coagulation model of cosmic aerosols for a total influx of silicate cosmic dust of approximately 500 t/day if $\delta \approx 0.3$ g/cu cm and for $\gamma\gamma\mu \approx 2000$ t/day if $\delta \approx 2.5$ g/cu cm. Intermediate values tie $\gamma\gamma\mu \approx 1000$ t/day to $\delta \approx 1$ g/cu cm. Such values are not in conflict with the data of any techniques for the study of cosmic dust and the Earth's atmosphere. The most probable source of influx of silicate cosmic dust is snow nuclei of minicomets, in which case the intermediate $\gamma\gamma\mu$ and δ values are most likely to hold. The principal contribution to aerosol scattering of light in the mesosphere is made by quasi-Rayleigh particles with radii of 0.1 μm or less. The condensation of vapors of meteoric matter occurs primarily in the lower thermosphere and in the region of the mesopause. As aerosols descend in the atmosphere, they coagulate. In the region of the stratopause, most of the aerosols have particle masses of 10^{-15}-10^{-14} g, which is optimal from the standpoint of light scattering. Figures 4, references 26: 14 Russian, 12 Western.

Identifying Optically Typical Sectors on Lunar Disk From Albedo and Degree of Polarization

927Q0219E Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 26, No 3 May-June 92 [manuscript received 25 Jan 91; resubmitted after correction 17 Oct 91] pp 99-110

[Article by O. I. Kvaratskheliya, V. V. Noviko v, Kh. G. Tadzhidinov, State Astronomical Institute imeni P. K. Shternberg, Scientific Research Center of Space Research; Abastumami Astrophysical Observatory]

[Abstract] Two traditional astrophysical parameters of light reflected from the lunar surface are examined here: albedo (ρ) and degree of polarization (P). Using the relatively recent technique of digital processing of the data of polarization images, the researchers here conducted a two-parameter classification of the lunar surface based on the relationship of ρ and P. Test areas chosen were the landing sites of the Apollo 11 and 15-17 spacecraft and the Luna 16, 20, and 24 spacecraft. Those regions are well studied, and the researchers produced polarization images and created software for computer processing of the lunar negatives. The seven test regions, each of which was approximately 800 sq km in area, were typical for 39 percent of the surface of the eastern part of the lunar disk. A simplified system of geochemical interpretation of lunar optical parameters was advanced. Figures 6, references 16: 12 Russian, 4 Western.

Theory of Motion of Planetary Atmospheres

927Q0205 Minsk DOKLADY AKADEMII NAUK BSSR in Russian Vol 35 No 11, Nov 91 [manuscript submitted 28 Mar 91] pp 1018-1022

[Article by A. I. Dobrolyubov, Institute of Technical Cybernetics, Belorussian Academy of Sciences; UDC 550.3:551.46]

[Abstract] The lack of an unambiguous explanation for the superrotation of the upper layers of planetary atmospheres prompted this researcher to create a model based on gas-tube studies to show that the sublatitude nature of the motion of the atmosphere on planets like Saturn, Jupiter, Neptune, and Uranus is driven not by the Sun, but by planetary satellites. Planetologists generally feel that the motion of the gas envelopes of planets is accompanied by phase transitions of gaseous media into a solid or crystalline state in the form of suspended crystals or flakes of ice, ammonia, and carbon dioxide (as a result of thermal factors). This researcher, however, uses his model to suggest that a different mechanism is at work. Ultimately, he points out that those planets have massive natural satellites nearby, revolving in planes close to the plane of the equator. The tidal forces acting on the planets are considerably greater than that of the Sun. The tidal forces in the atmospheres of the four planets move in an equatorial plane, resulting in a primarily sublatitude motion of the atmospheres. Figures 2, references 3: 1 Russian, 2 Western.

Zonal Wind in Southern Polar Regions of Venus From Radio Occultation Data

927Q0227A Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 30, No 3 May-Jun 92 [manuscript submitted 20 Mar 91] pp 390-395

[Article by V. N. Gubenko, S. S. Matyugov, O. I. Yakovlev, I. R. Vaganov; UDC 535.24:523.42]

[Abstract] Temperature and pressure data gathered via radio occultation by Venera-15 and Venera-16 for 17 regions of the southern hemisphere of Venus (60-89° S

lat) are used to assemble altitude profiles of the zonal wind velocity for the polar and near-polar regions for altitudes of 50-80 km. The techniques for making the measurements and for processing the data were those used earlier by Yakovlev et al. (KOSMICHESKIYE ISSLEDOVANIYA, 1987, Vol 25, No 2, p 275), and the average radius of the planet was assumed to be 6,051 km. The researchers hypothesized that approximation of the cyclostrophic balance is valid for the upper layers of the Venusian atmosphere, in which case zonal wind velocity can be determined by balancing three forces—pressure gradient, centrifugal force, and the Coriolis force. The initial altitude profiles of temperature and pressure produced a set of values for those parameters between 40 and 90 km above the surface. Twenty-eight fixed levels of pressure, from 1098 to 5 mbar, were delineated in the range of pressure variation for those altitudes. The temperature at those levels of pressure was found via linear interpolation of the values of temperature at levels of pressure close to those chosen as fixed levels. A common trait of the altitude profiles produced of the wind velocity at latitudes of 72, 74, 76, and 78° was the growth of velocity with altitude between 50 and 62 km. At 62 km, which corresponds to a pressure of 149 mbar, wind velocity reaches 80 m/s-1 at 78° S lat and 110 m/s^{-1} at 72°. The altitude of the local maximum diminishes virtually linearly when going to lower latitudes. At latitudes of 66-70°, wind velocity at the local maximum decreases with latitude, but the altitude at which the maximum wind velocity is observed rises to 63 km. The researchers postulate the existence of a jet stream between latitudes of 70 and 72°, its axis passing through an altitude of 62 km and its maximum wind velocity reaching 115 m/s^{-1}. They note that the temperature data spread due to space-time variations in atmospheric conditions leads to errors in the determination of latitude temperature gradients and, consequently, to errors in the determination of wind velocity. The initial conditions chosen by the researchers are another possible source of error. They place the error associated with wind velocity at the initial level at no more than 10 m/s^{-1}. Figures 5, references 21: 11 Russian, 10 Western.

Interaction of Solar Wind and Planets Mars and Venus Throughout Solar Cycle

9 27Q0227B Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 30, No 3 May-Jun 92 [manuscript submitted 8 Feb 91] pp 396-419 [Article by T. K. Breus; UDC 523.72:523.43]

[Abstract] Data gathered by Fobos-2 are compared with those of the Mars-2, -3, and -5 vehicles, and the properties of the boundary regions observed in the interaction of solar wind with the planets of Mars and Venus and Halley's Comet at the solar maximum and minimum are compared. Fobos-2 plasma and magnetic measurements during the solar maximum identified a magnetopause, or planetopause, at altitudes of 850-1000 km. That boundary region, however, differed substantially from a magnetopause formed by a planet's magnetic field in that its position was highly stable. Also intersecting the shock front in circular orbits near the terminator, Fobos-2 noted an asymmetry like that observed by Mars-2 at solar minimum, but an order of magnitude smaller. The "magnetopause" of Mars, however, is unlike that of Earth in its behavior upon exposure to higher pressures of solar wind. The hypothesis of an ionospheric barrier against solar wind near Mars meets with a number of difficulties, not the least of which is its inability to explain the asymmetry of the shock wave on the descending and ascending segments of the orbit of Mar-2 and -3 at solar minimum. Although Venus and Halley's Comet share morphological features of solar interaction at high P_{dyn}, there is a substantial difference between the scales of the regions in which the effect of a neutral atmosphere manifests itself. A barrier similar to a cometopause does form near Mars and Venus, but only during periods of high dynamic solar-wind pressure or during the solar maximum. Mars's "magnetopause" also has features similar to the upper boundary of Venus's ionosphere during periods of high dynamic pressure. The researchers conclude that the most probably scenario of interaction between solar wind and Mars is as follows. During the solar minimum the Martian barrier is formed by the planet's magnetic field. A neutral atmosphere is found only during periods of high dynamic pressure.

At solar maximum, the interaction assumes a cometlike nature, regardless of whether the barrier near the planet is ionospheric or magnetospheric. Near Mars, a boundary forms like a cometopause above the boundary of the balance of forces. Figures 12, references 50: 8 Russian, 42 Western.

Secular Variations of Magnetic Moment of Mars?

927Q0227C Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 30, No 3 May-Jun 92 [manuscript submitted 19 Dec 91] pp 425-428

[Article by Sh. Sh. Dolginov; UDC 621.317:523.43]

[Abstract] In seeking to determine whether the different magnetic data gathered by the Mars-2, -3, and -5 probes, on the one hand, and Fobos-2, on the other, indicate actual changes in the Martian magnetic moment, Dolginov points out that the f coefficient (characterizing the properties of the magnetosphere) is not constant, but depends on the sign and the magnitude of the B_z component of the interplanetary magnetic field. He produces a corrected figure for the error in determining M_M—6 percent and cautiously hypothesizes that a comparison of the magnetic moments measures by the earlier Mars probes and by Fobos-2 identifies secular variations in the planet's magnetic field. He suggests that attention should be paid to the similarity of the phases of change of the magnetic fields of Mars and Earth—in both cases, a diminution of the field. The variation that is identified and the nearness of the axis of the dipole to the axis of rotation suggests that the Martian field is linked to a dynamo process active in this age in a fluid, conducting planetary core. References 16: 6 Russian, 10 Western.

New Aircraft Design Said to Have Applications for Future Aerospace Planes

LD1910183992 Moscow ITAR-TASS in English 1646 GMT 19 Oct 92

[By ITAR-TASS correspondent Yuriy Kozmin]

[Text] Moscow October 19 TASS—Russian scientists in St. Petersburg are creating a supersonic "Ayax" [Ajax] flying craft which can provide leading positions for the country in exploration in upper layers of the atmosphere and the near space, according to the "EKHO PLANETY" weekly.

One of "Ayax" designers, Vladimir Freinshtadt, told the weekly he had completely changed the strategy of supersonic flights and introduced his own design which has no analogues in the West.

Earlier press reports said the concept is based on the principle of active energy interaction of the construction with environment. For the first time in history of transport vehicles the plane will not be protected from external energy sources, but, on the contrary, it will allow the energy to freely penetrate inside and increase power resources of the system.

The multi-purpose plane will be capable of flying nonstop up to 10,000 kilometres at a speed exceeding 1,000 Kph. The range of altitudes varies from 30 to 60 thousand metres.

"Ayax" designers believe the plane can become the basic element of the next generation of air-space systems. In particular, it can be used to create a one-stage air-space plane.

Independent experts believe, according to the weekly, that the craft designed in St. Petersburg differs in principle and is more promising than most Western researches. Foreign companies are going along traditional schemes which hardly promise a breakthrough. The implementation of the "Ayax" project might allow to make a qualitative leap ahead in the field which is the basic one for air-space industry. Thus, the Russian industry gains a chance to return the lost positions in the field of civil aviation construction and to join the vanguard of producers.

One of the main peculiarities of the project is that it might be used to protect the environment. The use of special ozonisers in the upper layers of the atmosphere will allow, for instance, to close ozone holes.

Almaz Satellite Proposed for Ecological Monitoring System

927Q0237 Moscow NEZAVISIMAYA GAZETA in Russian 17 Sep 92 p 6

[Article by Andrey Vaganov, under the rubric "A Project": "We May Still the Sky in 'Diamonds'"]

[Text] Many of the films that today are regarded as domestic and world classics were saved from the destruction linked to "reasons of ideology" thanks the bravery of certain film studio workers.

Less well known are the cases in which the selflessness of scientists, engineers, and workers saved from destruction creations of man's scientific-technical thought.

On the day of his 75th birthday, Leonid Brezhnev, urged on by Dmitriy Ustinov, signed a decree that shut down the program for using the Almaz [Diamond] space stations. Ustinov's "touching concern" for the domestic space program had deep roots. The developer of the unmanned Almaz stations was the prominent scientist and talented designer Vladimir Nikolayevich Chelomey, whom Ustinov was never very fond of.

When the vehicle was ready for launch—all that was left to do was fuel the launch vehicle—it was removed from the pad with an order that it be disassembled into parts for stockpiling. But they managed to hide the Almaz in a protected hanger, where it was stored until 1986. That's when a decision was made to re-open the program. And in July of next year, the Almaz will be launched into orbit.

Today, the Russian Academy of Sciences Space Research Institute and a number of institutes of the NPO Mashinostroyeniye are working on a project called "Space Laboratory for the Study of the Earth as an Ecological System," which will use vehicles such as the Almaz.

"The possibilities of these stations exceed what the Americans have just put into a project for realizing the international environmental monitoring program EOS (Earth Observing System)," says Prof. Valentin Etkin, head of the department of applied space physics of the Space Research Institute. "Our Almazes carry 6.5 tons of "science," as opposed to the 3.5 that the Americans plan to carry."

It should be added that, besides all else, our Almazes also cost less than what is programmed to be spent by the Americans. But the main merit of the Almazes is that it is possible to use them to realize the concept of a heavy systems environmental satellite. Three or four Almazes would be enough to create a system of global monitoring of the Earth.

The development of the "Space Laboratory" is now in the technical proposals stage. The proposals have been adopted as a whole and approved. But the Russian government still hasn't given the money for the development of the "Space Laboratory." That, in the opinion of Valentin Etkin, is another mistake.

Illustration of Variability of Spectral Brightness Coefficient of Open Sea From Interkosmos-21 Measurement Data

927Q0199A Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 3, May-Jun 92 [manuscript submitted 9 Jan 92] pp 3-10

[Article by V. S. Suyetin, V. V. Suslin, Marine Hydrophysical Institute, Ukrainian Academy of Sciences, Sevastopol; UDC 528.08.041.1:551.46.08]

[Abstract] Prompted by the fact that patterns of the geographic distribution and time variability of the spectral brightness coefficient of the ocean remain poorly studied for regions distant from land, the researchers here chose to examine data from measurements made of the radiation ascending from the sea surface by the MKS instrument during an experiment based on the Interkosmos-21 satellite. The MKS spectrometer performed measurements in 13 spectral sectors in the visible and near-IR ranges between 415 nm and 823 nm. Seven channels in the visible region (up to 675 nm) had a spectral width of about 12 nm. The instrument worked in the along-track mode and measured the ascending radiation in the vertical direction with a spatial resolution of about 10 km. Examples based on a working file of more than 40,000 spectra are presented of the variability for waters of varying turbidity. It is noted that the higher value for the spectral brightness in the vicinity of the South Atlantic pertains to the period of January/February, and the lower value to May/July. For the spectral interval in the region of 450 nm, the difference between them is greater than 2.5 percent, which constitutes nearly half of the range of variations of that magnitude in the ocean. The cloud-cover rejection criteria that were used are described by Suyetin and Suslin. Figures 3, references 19: 14 Russian, 5 Western.

Methods of Assimilating Satellite Information for Purposes of Analysis and Forecast of Atmospheric Ozone Fields

927Q0199B Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 3, May-Jun 92 [manuscript submitted 29 Nov 91] pp 26-34

[Article by K. Ya. Kondratyev, A. A. Buznikov, O. M. Pokrovskiy, Yu. B. Yanushanets, Center for Environmental Safety, Russian Academy of Sciences, St. Petersburg; St. Petersburg Electrotechnical University; Main Geophysical Observatory, St. Petersburg; UDC 528.88.041.1:551.501]

[Abstract] One important field associated with the study of the global ozone involves the improvement of existing two- and three-dimensional dynamics/photochemical stratospheric models. Procedures for adapting the models to the

data of actual observations should serve as the basis for the creation of predictive models that enable estimation of the effects of various anthropogenic factors on the variation in stratospheric gas composition (to include ozone) and evaluation of radiation conditions and dynamics. The development of space-time assimilation of remote-measurement data in the models being adapted produces a permanent user of the ozonometric information collected by satellites and enables forecast of the evolution of the global ozone field. The researchers here present a brief description of possible methods of spatial analysis of ozone fields based on ground and satellite observations. They examine the assimilation of satellite-derived data in a two-dimensional model of the atmosphere based on the use of spectral analysis. They use a complex of programs of numerical analysis and forecast of ozone fields that makes it possible to match satellite and ground data, smooth and interpolate spatial fields, identify erroneous observations, raise the level of accuracy associated with field analysis, analyze time series of amplitudes of large-scale anomalies, and improve the reliability of dynamics/photochemical models. Figures 4, references 8 (Russian).

Analysis of Algorithms for Retrieving Sea Surface Temperature on the Basis of Observations Made From NOAA and ERS-1 Operational Satellites

927Q0199C Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 3, May-Jun 92 [manuscript submitted 11 Nov 91] pp 35-41

[Article by N. A. Timofeyev, Marine Hydrophysical Institute, Ukrainian Academy of Sciences, Sevastopol; UDC 528.88.041.3:372.21.03.21]

[Abstract] Weather forecasting and the prediction of global climatic changes on the basis of numerical models of the ocean-atmosphere system require rather accurate data on sea surface temperatures t on a global scale. Only satellites can provide regular information on t with the requisite space-time averaging. A number of individuals have proposed techniques for retrieving t from data collected by operational NOAA and ERS-1 satellites, which carry the high-resolution radiometers AVHRR/2 and ATSR, respectively. An analysis of modern techniques explains that the initial information consists of radiation temperatures t_1, t_2, t_3 (°C) in the spectral intervals of 3.53-3.94, 10.3-11.3, and 11.5-12.5 μm. Measurements must be done on at least two wavelengths at an arbitrary satellite zenith angle θ at the point for which t is being determined, or at two θ angles if the wavelength is fixed. In ideal algorithms for processing remote-sensing data, the accuracy associated with the retrieval of t is defined as the σ_π error of satellite measurement systems. This paper presents a comparative analysis of the accuracy of techniques for operational retrieval of sea surface temperature on the basis of measurements of radiation temperatures in two sectors of the IR spectrum. An algorithm developed at the Marine Hydrophysical Institute is shown to be capable of meeting the accuracy requisites of international research programs, which require that measurement error be brought down to 0.1°C, a feat that the McClain and Barton techniques cannot match. Figures 3, references 10: 6 Russian, 4 Western.

Some Aspects of Processing of Radar Data for Study of Boreal Forests

927Q0199D Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 3, May-Jun 92 [manuscript submitted 8 Jan 92] pp 50-61

[Article by G. I. Belchanskiy, I. N. Mordvintsev, G. K. Ovchinnikov, V. G. Petrosyan, Institute of Evolutionary Morphology and Ecology of Animals, Russian Academy of Sciences, Moscow; UDC 528.854:535.36]

[Abstract] The integrated processing of radar and optical images of differing resolutions is little studied, despite the fact that such processing is extremely important to the solution of global environmental problems, the creation of a global Earth observation system, and the effective use of today's geographic-information technology for interpreting remote data. This paper examines some of the results of the study and creation of software for the integrated processing of UHF remote-sensing data based on the use of the low-resolution Okean radar and synchronous aerial and ground observations. Also examined are certain aspects of forest monitoring, namely, the creation of timber-resource geographic-information systems. The general system for the integrated processing consists of experiment planning; collection of data; and storage, processing, and display of data. The latter component includes a core subsystem whose main elements include a system for preliminary processing of radar images, a system for image classification, and a thematic mapping system. The initial data for the subsystem consists of synchronous space-derived data and aerial imagery, the data of systematic ground observations, and radar parameters. Backscattering coefficients or intensities can be used as the initial data for interpretation. Backscattering coefficients are computed simultaneously with geometric corrections and geographic references. The software is run in Borland C language for IBM PC AT or PS/2 computers with VGA graphics adapter card and 30 MB disk space. Figures 6, references 15: 7 Russian, 8 Western.

Evaluation of the Possibilities of Identifying Poppy Fields With Photometry

927Q0199E Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 3, May-Jun 92 [manuscript submitted 26 Nov 91] pp 67-75

[Article by L. M. Matiyasevich, D. V. Kochergin, Yu. L. Subbotin, V. N. Mamatulin, State Scientific Research and Production Center Priroda, Moscow; UDC 528.711.1(202).007]

[Abstract] The technology for identifying illegal poppy fields must meet two principal requirements: reliability and timeliness of information on location of the fields, and low cost. One such technology that is being developed in a quantitative-photometric method of identifying poppy fields. The principal distinguishing feature of photometry in this regard is its use of the brightness characteristics of the objects themselves as identification criteria, rather than optical densities of image, thereby enabling the production of a bank of criteria, eliminating the need for much of the ground-based investigation that is done, making the acquisition of identification data faster, and lowering the cost of all the operations involved. Two types of photometry are pronounced possible for poppy field identification: visual-instrument photometry, and automated photometry. Both use a process for determining zonal brightness coefficients that was developed at the Priroda state center on the basis of aerial photography materials. Essentially, the process consists in finding a standard quantity of illumination that corresponds to the optical density of the image of the object and computing the zonal brightness coefficient as a function of the parameters of the hardware, the survey conditions, the amount of light, and the characteristics of the sensitometer and film. Aerial survey of various regions demonstrated the capability of identifying poppy fields in land forms such as desert, mountain, and floodplain. Figures 6, references 4: 3 Russian, 1 Thai.

Estimation of the Parameters of Soil-Vegetation Cover From Multispectral Satellite Data

927Q0199F Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 3, May-Jun 92 [manuscript submitted 2 Sep 91] pp 88-95

[Article by K. Ya. Kondratyev, N. V. Vandysheva, V. V. Kozoderov, V. S. Kosolapov, Center for Environmental Safety, Russian Academy of Sciences, St. Petersburg; Institute of Computer Mathematics, Russian Academy of Sciences, Moscow; UDC 535.243.1:632.2]

[Abstract] Among the parameters characterizing the state of the biosphere is volume of vegetation phytomass. The researchers here demonstrate the use of a procedure of atmospheric correction in the context of thematic interpretation of remote sensing data. They estimate the accuracy of the retrieval of phytomass characteristics from multispectral satellite imagery that allows for atmospheric influence. Error does not exceed 3-5 percent. By way of example, data from the Kosmos-1939 satellite in the FIFE-89 experiment are processed. The Kosmos-1939 carried an MSU-E multiband, optoelectric, high-resolution scanner and an MSU-SK mid-resolution, conical-sweep scanner. The MSU-E data analyzed was from 14 April and 9 August 1989; the MSU-SK data, 4 August 1989. Researchers were able to evaluate land-surface ecosystem state and retrieve parameters from the ecosystem from over the state of Kansas. Photos detailing the distribution of phytomass volume on the Kansas prairie are included in the article. Figures 4, references 6: 4 Russian, 2 Western.

Proton Engine Manufacturer Not Being Paid, Facing Shutdown

937Q0001 Moscow ROSSIYSKAYA GAZETA in Russian 7 Oct 92 p 3

[Article by Yuriy Shatalov, under the rubric "Space and the Market": "'Proton' Is Flying Toward a Dead End"]

[Text] The Perm State Enterprise Motorostroitel [Engine Builder] produces rocket engines—the RD-253. To be more precise, that's the first, most powerful stage of the three-stage Proton launch vehicle. That rocket lifted the Salyut and Mir orbital stations into orbit. Thanks to the Proton, we have communications satellites that deliver television and radio signals to the most remote corners of the country. In a word, we're talking not about military equipment, but about the exact opposite—equipment that operates for peace and prosperity. But now the funding of space programs is being cut back, and Proton isn't being claimed by anyone. For the first time in our rocket-building history, the Moscow head enterprise this year did not purchase a single engine from [the Perm enterprise]. Worse yet, the contract for the deliveries of the RD-253 for 1993 has not been signed. And what are the Muscovites themselves doing to solve the problem—after all, the Proton, despite all this, is still flying? "They still have a small stock of them, because we have never stopped our planned deliveries of that engine," says the deputy general director of Motorostroitel, V. Marchenko. "But we have reliable information that the plant will shut down in 1993 if, of course, nothing changes." It's not hard to see that the head enterprise isn't buying rocket engines from the Perm people not because they don't need the engines. They need them, and how! The problem is that they don't have any money to pay for them—the plant, like all the enterprises of the general machine-building department of the Russian Federation Ministry of Industry, is going through a severe economic crisis.

But, in saving itself, the head enterprise is jeopardizing its partners from Perm. The Perm people, of course, realize that the RD-253 engines will be needed sooner or later. They realize that, and they continue to produce the engines, sustaining huge losses in order to preserve business ties. Since April of this year, officials of the Perm State Enterprise Motorostroitel have gone to the highest offices more than once, asking them to resolve the question of the funding of the production of the first stage of the Proton rocket or transfer the order to other plants of the general machine-building department. No one from any of the capital's offices has said no. But there is still no money coming for the production of the RD-253. That's why the Proton continues to rush along at a frightful speed...toward a dead end.

Budget, Plans for Russian Space Program Discussed

927Q0234 Moscow TRUD in Russian 15 Sep 92 p 2

[Article by Vitaliy Golovachev, poli tical reviewer for TRUD: "What's the Purpose of the Shuttle Going Up to Mir?"]

[Text] Not so very long ago, that beautiful, multistoried brick building with the openwork antennas on its roof was one of the secret "facilities" in the center of Moscow. It housed the headquarters for the rocket-space sector—the Ministry of General Machine Building (MOM). There is where the invisible threads came together from the rocket plants, the cosmodromes, the design bureaus, and the test ranges. All the people who worked in MOM signed an agreement that they would not divulge any information constituting state secrets (and virtually everything was a state secret). Upon leaving the building, those people never spoke about their work, fearing not only "enemy ears," but also the KGB.

And then the curtain of secrecy fell. Instead of MOM occupying the building now, it is occupied by the Russian Space Agency under the jurisdiction of the President of Russia. And the address is no longer a secret: Mius Square, No 3. And not only that, but the meeting of the board (not just "for show" now, but a working board), in which the drafts of the space program for 1993 and for the period up to the year 2000 were hotly discussed, allowed journalists in.

This year, the spending for military space programs has been cut drastically, in half. That's to be welcomed in every regard.

But the Supreme Soviet also allotted less money for "civilian space"—8.72 billion rubles [R]. At comparable prices, that's roughly 1.5-fold less than either 1990 or 1991.

But an additional $30 million (or R6 billion, if you convert to the market rate of exchange) has been earned for the commercial launches of foreign cosmonauts. There's enough money for the most important design work and research, although the money has to be counted very carefully. Of course, they've long forgotten about high wages here. In many groups, people are working and living primarily on their enthusiasm. In the Scientific Research Institute of Precision Instruments, for example, the average monthly wage in the first six months of the year was R1,340, when the minimum needed to live (at a survival level) was over R2,000. In most of the enterprises of the sector, the average wage is no higher than R1,700. We are always dashing from one extreme to another. First we have almost half of the country working in space, then we doom the best of our personnel to an abject existence.

Just what awaits the space program next year, in 1993? Which areas will become the primary areas? How much money will be needed for them?

One of the most acute problems we're faced with is the rapidly rising prices for metal, materials, and fuel. A ton of the rocket fuel that's called "cyclin" [tsiklin], for example, costs nearly R2 million (!), whereas last year it cost R26,000. The cost of copper rolled-stock has risen 132-fold (to a quarter of a million rubles per ton). And that's how it is for everything down the line.

As a result, a Soyuz craft has come to cost R95 million, and a launch vehicle, R56 million; whereas the launch of a Soyuz craft costs R310 million. That's seven-11 times more expensive than last year. Which is why even the most needed, most drastically cut space programs with economic or science missions will require more than R22 billion next year.

That is placing new challenges before our space sector. Before, it used to be happily reported to the people that the space sector was producing immense economic gains. But they were "hypothetical" gains, and more often than not, they were only on paper. In fact, it was something that nobody cared about. Today, concerns, firms, and scientific-production associations need to earn not hypothetical profits, but very real profits, and they need to begin working on the basis of orders, on a commercial footing, so to speak. That also goes for sensing the Earth from space (we've been "probing" for 15 years already now, but there haven't been that many tangible results); the in-orbit production of drugs, crystals, and other materials; the launching of commercial satellites...

We need to be vigorously penetrating the world market, although our American partners, if the truth be known, have, until quite recently, been energetically opposing our entry with all sorts of bans. We are offering today to place foreign satellites into orbit for $50 million, whereas the world price is $70-80 million. But even with that, our dealings in the international space arena constitute only 0.5-1 percent of all the business done there. Beyond any doubt, that does not represent a level of growth for our space sector.

When the United States 20 years ago forbade the use of the Franco-German telecommunications satellite for commercial purposes, since it had been launched with an American Delta rocket, Europe decided to build its own rocket, the Ariane, and thereby avoid being dictated to. That's not a bad example for Russia, which could offer its partners not only rockets, but also the satellites themselves—telecommunications satellites, navigation satellites, environmental satellites, and many others. But to do that, we have improve the quality, reliability, and lifespans of space vehicles, because we are very far behind in that area.

One can only welcome a phenomenon that is completely new to our space program: many of the projects being proposed have a material explanation—"financed on a commercial basis." However, in my view, there still aren't quite enough such projects. The space program is developing now in a manner unlike before. In the first place, a project is incorporated in the program when there is not only an organization proposing it, but also a customer, that is, a consumer of the "space product." Second, all projects go through an independent interdepartmental committee, which examines them for timeliness and usefulness.

In addition, it's understood that there can't yet be a space program that pays for itself completely —that's something that is confirmed by worldwide experience. Which means that state support is necessary. Just maintaining the cosmodromes takes R8 billion today. And that's just to keep them open.

Of course, with regard to Baykonur, some specialists have raised the question, Won't we be spending money for nothing? Won't we have to leave it at some point in time and transfer all launches to, say, Plesetsk? But even a dilettante can see that the operation of Baykonur is in the interests of Russia, as well as Kazakhstan. If Russia were to leave, the cosmodrome would very quickly become just a junkyard.

We need to find money in the treasury, but we have to spend it thoughtfully. I'm not so sure, however, that all of the decisions that have been made today are the best decisions. For example, in connection with our reduction of the number of missiles we have, we are burning the rocket fuel, heptyl, which is no longer needed. But each ton of it costs R1.2 million. Some 100,000 tons of heptyl and other types of fuel are to be burned up. Tens of billions of rubles will go to the wind! Can we really not find a better solution?

I'd especially like to pause on the development of Russian-American cooperation in the exploration of space. Some interesting prospects are appearing there. Negotiations are under way with regard to several projects. In October 1993, a Russian cosmonaut may make a flight aboard an American spacecraft of the Space Shuttle series. In the next 10 days, two of our candidates are to be chosen for that slot, and they will soon after leave for the United States—there's just barely enough time left for training for the mission. S. Krikalev, V. Solovyev, V. Titov, A. Serebrov, Yu. Romanenko, and V. Savinykh have expressed a desire to fly aboard the Shuttle. It is entirely probable that others will also want to do so. Each of them will undergo a thorough medical examination. Then a special commission will make a judgment on the professional skills of the candidates, as well as on how well they speak English. And finally, on 25 September, the commission will choose one military flyer and one engineer for the trip to the United States. The Russian cosmonaut will, among other things, work on the Shuttle with the manipulators, which could turn out to be useful in the future during loading/unloading operations if the project calling for the docking of the Shuttle and the Russian orbital station Mir is carried out.

That is a second, more interesting project. The Americans are proposing that in December 1994 a U.S. astronaut be included in one of our crews and travel aboard a Soyuz to the Mir station. The orbital watch of the astronaut should be lengthy—three to three and a half months. Then in late March 1995, the American Shuttle will dock with our space station. In the process, it can fly there not empty, but with fuel and dry cargoes for Mir, taking the place of the regularly scheduled flight of our Progress cargo resupply craft. At the same time, the Shuttle can deliver to Mir two of our cosmonauts, who will replace their colleagues who have completed their

stint. Thus, a manned Soyuz will not have to be launched. The Russian cosmonauts who have completed their work on Mir and an American astronaut will return to Earth on that same Shuttle.

The commercial aspects, I think, will require additional agreements, but even at today's prices, the cost of the "economized" launches of the Soyuz and Progress will be nearly R600 million.

The Americans are very interested in such cooperation, because they don't have experience in extremely long space missions. Russian has unique materials in that area. It would seem that the transfer of such priceless experience shouldn't be for free.

In the future, cooperation in space projects would help make considerable headway in the organization of global environmental observations from orbit, in the study of natural resources, and in the creation of an effective system for early warning against natural disasters, environmental anomalies, and catastrophes. By the way, during the last powerful typhoon in the southern United States, 18 people died, but 470,000 were evacuated on time thanks to warning information received from space vehicles.

"We are ready for cooperation with the Americans and other partners in many areas," says the director of the Russian Space Agency, Yuriy Koptev. "For example, in the creation of general systems—navigation systems, rescue systems, transportation systems, etc. Cooperation in space projects will be useful and beneficial for all participants."

And that's one more argument in favor of our space program. It must develop. But it's important that we simply not repeat the mistakes of the past.

Funds To Be Allocated for Continuing Buran Program

927Q0217 Moscow NEZAVISIMAYA GAZETA in Russian 12 Aug 92 p 6

[Article by Yu. Meshkov, under the rubric "Space Program": "'Buran' Could Have Perished: But It Has Been Saved, General Designer Assured Journalists"]

[Text] No matter how one regards the current state of the domestic space program, Buran invariably ends up the focus of attention. That hunk of metal is very noticeable and expensive among all our space-related programs. The perplexity of its creators was understandable as they helplessly watched what they had created be destroyed. And that, in a very literal sense, not by the day, but by the hour. A revival effort that would be able to bring the entire reusable-spacecraft complex back to life was needed immediately. And it looks as if the money to do just that has been found in the CIS countries. Nearly 4 billion rubles will be directed to a continuation of the program. The general designer and general director of NPO Energiya, Yuriy Semenov, recently reported that. Buran's next flight should take place as early as next year.

In the meantime, "article No. 2," as the specialists making the preparations for the flight call Buran, is going through electrical tests on the jig in the assembly-and-testing building at Baykonur. That craft, unlike its predecessor, is equipped with a life-support system for the cosmonauts who are slated to finally test it in space. Buran, however, will be placed into orbit in unmanned mode. After it docks with the Mir orbital station, the cosmonauts will transfer to the shuttle, where they will work for seven days. Then they will return to the station, and Buran will land in automatic mode. That's what the program calls for. Of course, there may be changes, which the general designer has a right to make. He has the final say.

But before our hearts fill with the customary pride over a new victory in space, there's a lot of work to be done on the ground. The main thing is to restore the launch complex, where the necessary routine inspection and maintenance haven't been done for nearly a year and a half. I visited the launch pad for Energiya/Buran recently. It was a dismal sight. You could have shot science-fiction films there about a dying space civilization! Everything you'd need for the set was there! A Hollywood film magnate could only dream of such scope and desolation.

Of course, the space-related hardware they work with in the laboratory has been kept in much better condition. And that's something to be proud of. For example, Buran's docking module. When the NASA director was shown our developments, he gave high marks for the originality and reliability of the designs. (In that area, the Americans are clearly behind.) His words were instantly followed by deeds: in late July, an agreement was signed on the acquisition by the American side of four docking modules. Now we just have to make intelligent use of the hard-currency revenues we get.

On 18 August, another agreement is expected to be signed—an agreement involving the 1993 flight of our cosmonaut aboard the American Shuttle. According to the agreement, an American astronaut in turn gets the opportunity to perform a spaceflight aboard a Soyuz craft and the Mir orbital station. There is every reason to believe that this time the agreements reached will not become a subject of interest of just the politicians, but will serve as the beginning of the so-long-awaited technical cooperation between the former USSR and the United States in space.

Deterioration of Facilities at Baykonur Cosmodrome

927Q0220 Moscow GUDOK in Russian 8 Aug 92 p 3

[Article by B. Olesyuk, Moscow: "Is the Star of Baykonur Setting?"; first paragraph is source introduction]

[Text] **Baykonur, known to the entire world nowadays, sprang up, one might say, overnight on the boundless Kazakh steppe. In olden times, that steppe, flat as a billiard table, resounded with the clatter of hooves and the ringing of camel bells. Passing through here was one of the paths of the Great Silk Route, which stretched from**

the Chinese city of Lanzhou to the Baltic states. It took two years in all for the first launch complex to shoot up in those totally inhospitable environs and for the first space satellite to depart from its docks to the space beyond the planet's threshold.

That evening, 4 October 1957, the steppe shook beneath the unprecedented thunder of rocket engines whose power and force exceeded that of all the horses on the globe. It was the voice of the first space port of the people on Earth, the virgin Baykonur.

Just a few months before that, it was what could be called a truly all-national construction project. Taking part in the erection of the cosmodrome were all the republics who had realized their achievements in construction, metallurgy, mechanics, power engineering, chemistry, automation, and electronics.

Just a small bit of information. The first cosmodrome in our country was erected soon after the war in the vicinity of the village of Kapustin Yar, in Astrakhan Oblast. The first single-stage ballistic missile launched from there on 18 October 1947. The decision to built a bigger cosmodrome in Kazakhstan came later, in a complex international situation, at the height of the "Cold War."

Three areas were selected preliminarily for the construction of the new cosmodrome. The first, and most promising, was in the remote taiga of Mari ASSR, on a large plot that had been cleared during the war. The second was on the shores of the Caspian, in Dagestan. The third was in the Kazakhstan steppe. The choice of Kazakhstan was unexpected for many.

And another curious fact. For many years, the cosmodrome was behind a curtain of the strictest secrecy. To hide the true location and confuse a probable enemy, it was called Baykonur, even though the actual Kazakh village by that name was 300 km to the northeast. That beautiful name came to be what the cosmodrome was known by. By the way, Baykonur translates from Kazakh to mean "golden expanses." The CIA, however, easily calculated the coordinates of the cosmodrome and called it by its true name, Tyura-Tam.

Baykonur grew and matured a long with our space program. Now it covers such a large area that one can't even take the whole thing in with a glance from an airplane. Journeys to the Moon, Venus, and Mars begin on its launch pads. Spacecraft and orbital stations, as well as the communication satellites Ekran and Gorizont, depart for the space suburbs of Earth from there. The diagram included here indicates the launch complexes for the Soyuz and Progress passenger and cargo craft, the Mir orbital station, and the Buran reusable craft, plus the 4.5-kilometer-long concrete strip for Buran landings.

It represent s a very complex, multisector physical plant. It may be that only God knows how much money is invested in Baykonur. A figure of 4 billion is named. But one must question that figure, since just one pad for the launch of Proton rockets costs nearly a billion. And at

Key: 1. Baykonur Cosmodrome—2. Yubileynnyy Airfield—3. Proton—4. Energiya—5. Energiya/Buran—6. Vostok—7. Observation post—8. Soyuz—9. Vega—10. KAZ (oxygen-nitrogen plant)—11. Saturn—12. Zenit—13. Krayniy Airfield—14. Tyura-Tam—15. Leninsk—16. Syrdarya River

Baykonur there are four such pads. Add to that the launch complex that—unique in scale, capabilities, and equipment—supports the preparations and launch of the Energiya rocket and a "billion in concrete," and you get a round sum of 10 billion rubles.

In addition, laid out on the steppe are city blocks of a large, modern city with wide avenues and plazas, squares and parks, schools and movie theaters, kindergartens and stores. More than 90,000 people live there. The construction of the capital of Baykonur—Leninsk—was also quite expensive.

Today, Baykonur finds itself in alarming straits and with concerns. It is alive and functioning. But its launch facilities are working barely at half strength. And Baykonur would be unthinkable without space launches.

The star of Baykonur has begun to set. Its swan song was the November 1988 launch in which the powerful Energiya rocket carried our first space shuttle Buran up into the starry reaches.

Since then, the cosmodrome has begun to decay right before our eyes. The situation that has come about there is a joyless one. With an incredible amount of effort, the people there have managed to maintain the viability of the launch complexes. But it's possible that public property built up with such a large amount of labor will suffer irreversible destruction. In which case, thousands of very highly skilled specialists will be forced to look for work. They are already being siphoned off.

Very serious complications are also being caused by another problem. The once fertile lands taken by the military for the fall of spent launcher components are literally seeded with metal scrap. No one has cleaned up the space trash.

Kazakhstan filed a suit against the Space Agency for the ecological damage it has caused, but then asked a sum that a little over twice the annual budget for the entire Russian space program. An agreement was reached that specified that the special unit at the cosmodrome will remove dangerous objects from the steppe.

The main snag, of course, is money. How much money does it take these days to maintain the huge cosmodrome and update the equipment that is rapidly becoming obsolete? Baykonur was part one of the space units of the Ministry of Defense. It was always funded out of the military budget. But the money that is allotted it today amounts to crumbs. The water situation at the cosmodrome is bad, especially in areas far from the city. The roads are in disrepair. Accidents happen on the LEP (electric power lines) often. The stores don't have the most basic goods.

As a result of the breakup of the former USSR, Baykonur has gone under the jurisdiction of sovereign Kazakhstan, which did not hesitate to create its own Space Research Agency. The question inevitably arises, Is Kazakhstan capable today of independently running such a complex cosmodrome? It's absolutely clear to anyone who knows anything about rocket-space hardware that without a space industry or qualified personnel for servicing extremely complex equipment, running such a cosmodrome is impossible. The cosmodrome is a whole, a living organism, and it can't be divided into parts.

Russia has the Plesetsk cosmodrome, in Arkhangelsk Oblast. It accounted for nearly 70 per cent of all launches in the former Union. Unfortunately, there are no launch facilities there for manned spacecraft or for the Proton or Energiya rockets. So, for now, Russia can't do without Baykonur. And it was no accident that B. Yeltsin, during a working visit to Arkhangelsk Oblast, "took a peek" at the small, closed city of Mirnyy, where the Plesetsk launch crews live. It appears that the northern cosmodrome will, in the future, become Russia's primary space harbor. Of course, that will require a fair amount of spending.

For now, Russia has signed a military-political agreement with Kazakhstan in which the question of the joint use of the Baykonur Cosmodrome on a mutually beneficial basis is resolved. It will function on its customary schedule. Regular launches are already scheduled.

Utkin, Chertok, Koptev Give Views on Future of Russian Space Program

927Q0215 Moscow ROSSIYA in Russian, No 20, 13-19 May 92 p 11

[Article by Mikhail Arkhipov: "Flights When One is Asleep and When One is Awake"]

[Text] It looks as if the space program could suffer the same fate as the Black Sea Fleet in the very near future. At any rate, arguments about its "usefulness and immense costs" have already reached the Russian White House. As has one "protective" measure—the formation of the Russian Space Agency (RSA). And the Russian Academy of Sciences (RAS) has also been unable to remain in the shadows. The Academy was the initiator of a recently held conference devoted to the International Space Year.

Academician V. Utkin, the director of the Central Scientific Research Institute of Machinebuilding, noted in an address he gave there that shutting down the space program in the CIS would not only not halt the economic chaos, but would also even accelerate it indirectly. The chief role of the space program he nevertheless sees as the gathering of fundamental knowledge about the world around us. At the same time, "like the current dissemination of science-intensive technologies," the use of the space program as an instrument for the collective security of the Commonwealth "does not in any way create a threat to the peace."

Promising space projects, in the opinion of Utkin, continue to be expeditions to Mars and variations of the "space isolation" of especially dangerous and radioactive wastes. A great deal of attention must also be focused on a continuation of the study of the Sun—understanding what is happening on the Sun is linked in the most direct way to the continuation of life on Earth.

In the context of space-sector conversion, proposals have been made that military missiles removed from the arsenal in compliance with earlier concluded treaties limiting them be used for placing peaceful payloads into orbit. That issue must be resolved as quickly as possible, because the timeframes for their storage and use are getting shorter every year and are eight years as of today.

RAS corresponding member B. Chertok, representing NPO Energiya, began his story of the founding of that association first with the omissions and mistakes that resulted in deaths, as well as in morale and material losses associated with projects that were never completed, such as the N-1 (the landing of cosmonauts on the Moon). In addition, the activity of the NPO, in his opinion, has enabled the solution of a whole array of scientific-technical problems, such as effecting reliable operations aboard the long-duration Salyut and Mir orbital stations and developing a well-tested system for returning crews to the ground.

Continuing to garner experience, however, can only be done through active practical work. The Mir station has been in operation for six years already, and a good many modules of varying purposes have been docked to it. But without the main crews maintaining a permanent residence aboard it, and because of the impossibility of mothballing it from an engineering standpoint, Mir could "doze off forever" in a matter of one and a half to two months time. In addition, plans for the near future

call for "outfitting" the space laboratory with two more modules and attempting to solve the problem associated with delivering science information from the station to the ground in some way other than returning it with the crews.

Moreover, the firm has been intimately involved in developing new techniques for "removing" cargoes from orbit with special capsules that hold as much as 150 kg. That innovation would undoubtedly expand the capabilities of Mir, were it not for one "but." Will it not become just another "bicycle demonstration model" like the yet-to-be-ridden Buran and remain in the association's museum collection?!

And another thing. Not to belittle the accomplishments of NPO Energiya, but its anticipated income from activity in space still seems overstated. Specifically, $20 million for the flight of the next foreign cosmonaut, a French citizen who will visit the Mir station in July 1992.

Closer to the realities of today were the words of the general director of the Russian Space Agency, Yu. Koptev, who brought everybody gathered there "back to the ground" by focusing on the practical problems of the space program. Although even he couldn't keep from describing as a definite success the country's creation of an advanced space infrastructure (specifically, three launch facilities and an entire array of well-tested launch vehicles of various classes) in a little over three decades. And, in Koptev's opinion, only the loss of a sense of reality can explain the fact that one of the few competitive sectors in the former Union is now, through our own fault as much as anybody else's, "bearing the cross" of being the "worst space program in the world."

Today, Yu. Koptev is raising questions that, at the top of the list of all his activity as director of the RSA, concern what society needs in terms of the space program and what the space program itself needs in terms of solving applied problems in which priority must be given unreservedly to the consumer and in which the entire burden of the "extraterrestrial g-loads" will fall to Russia as the legal successor of the former Union in the field of space research. Because, however, of the change in not only internal, but also external conditions, the republic is clearly not capable of shouldering many of the "Union" programs, and that means that they need careful adjustment. Russia, for example, does not need to maintain parity with the United States in the "space race"; nor does it need to maintain "preeminence" in the solution of many military problems or in the solution of a whole array of purely scientific problems. The current goal of the Russian space program this amounts to using the potential it has already garnered to bring to life, for example, urgent economic, scientific, and cultural plans.

A task of no less importance facing our space program today involves Russia's interest in entering the international market of "space services" by offering all interested parties its launch vehicles and the data accumulated in the course of manned and unmanned missions. Without a doubt, the "commercial" element must also be reflected in the Russian space program. For example, today already, individual projects such as the remote sensing of the Earth and the monitoring of the Earth's surface fetch profits of around 1.5-2 million rubles. One can't help but agree with the general director of the RSA that space facilities in whose use commercial structures both of Russia and of the other CIS members are showing interest can and must be used by them on the basis of jointly developed rights and duties. In light of the importance of the centralization of space activity, however, Koptev feels that control of the space activity could be effected by, for example, a Space Council attached to the office of the president of Russia.

Finally, as opposed to the multitude of consumers in the former Union who took the form of six departments and organizations, today it would be more logical to separate them into "areas of responsibility": the RSA, for example, would be responsible for national-economy-related launches, whereas the space units of the Combined Armed Forces of the CIS would be responsible for military launches. Thus, the future would be devoid of the total monopoly of the military, who for decades were responsible not only for military objectives, but also for national-economy-related and scientific objectives.

History of U.S.-Soviet Cooperation Discussed

927Q0221 Moscow NEZAVISIMAYA GAZETA in Russian 14 Aug 92 p 6

[Article consists of a dialogue between John Logsdon, who is the director of the Center for International Science and Technology Policy, a professor at George Washington University, and the editor of the North American journal, SPACE POLICY, and Grigoriy Khozin, a doctor of historical sciences, professor at Moscow University, and author of more than 150 works on the political and socioeconomic problems associated with the space program and with international cooperation in science and technology, under the rubric "Space Program": "The Path to Space: Together, or Separately? Lessons and Perspectives of the Cooperation Among the Scientists of Two Superpowers"; first two paragraphs are source introduction]

[Text] **Recent weeks have brought a good deal of news about the cooperation that is unfolding between Russia and the United States in the area of space. And the cooperation is not just small stuff, not just for show, as, more often than not, it was in the past. In the dry language of official protocols, it is "large-scale and long-term." Proof of that is a recent contract between the Russian Space Agency and NASA with regard to joint work involving the creation of a complex to support the operation of the long-duration orbital station Freedom (see NEZAVISIMAYA GAZETA, 23 June 1992); the contract mentions the flight of a Russian cosmonaut aboard the Shuttle and the flight of an American astronaut aboard a Soyuz, as well as other examples of an exchange of technologies and science data.**

But the efforts to establish mutually beneficial contacts between the two space powers came about not today or even yesterday. That is confirmed by the history of the development of relations between the United States and the former USSR in the field of space research, a history not reported to the general public until now and dating back to "Cold War" times. An unreported page in the space-related intentions of the two superpowers is opened by the publication of a dialogue between John Logsdon, who is the director of the Center for International Science and Technology Policy, a professor at George Washington University, and the editor of the North American journal, SPACE POLICY, and Grigoriy Khozin, a doctor of historical sciences, a professor at Moscow University, and the author of more than 150 works on the political and socioeconomic problems associated with the space program and with international cooperation in science and technology. The dialogue between the two scientists will be published in its entirety in the annual publication NAUKA I CHELOVECHESTVO, 1992 [Science and Mankind, 1992] which will come out at the end of the year. Today, the readers of NEZAVISIMAYA GAZETA have an opportunity to be the first to become acquainted with historical facts that are of especial interest in light of the events that are taking place.

LOGSDON: On my bookshelf, I have a book from the '70s, and its cover depicts the American reusable Space Shuttle transport craft docked with a Soviet Salyut space station. Such a mission was actually proposed in the wake of the hugely successful Apollo-Soyuz project, which was performed in 1975; but it failed to gain approval by the political leadership of the two countries, because of a worsening of Soviet-American relations in general. Now—when the flight of an American astronaut aboard the Mir space station, which was put into orbit by the Soviet Union back in 1986, is on the agenda, as is the flight of a cosmonaut from our country aboard the Shuttle—the public is again reminded of the linkup of the Soviet and American craft. One way or other, huge projects are again coming into vogue.

The space programs in the United States and the USSR came about in the age of the "Cold War." They sprang up and grew in an atmosphere of competition: each of the states was striving to prove to anybody who was the least bit interested in space which of the great powers was in the lead in terms of technology. Both countries stirred the pace of a race that endowed them with various preeminent achievements in space, and both used their technological feats as effective propaganda for influencing world public opinion. The launch by the Soviet Union in 1957 of the first satellite shook many Americans. "How could we have fallen so far behind?" was a question on the lips of political leaders as well as everyday citizens. "Why weren't we the first to launch a satellite?" But the fact is that the U.S. leaders had not particularly cared about being the first in space. They forgot about that completely, though, when everyone became seized by a feeling that was near panic. Americans were concerned: "If the Soviet Union was able to place a satellite into orbit, then it could easily use the same rocket to deliver a hydrogen bomb to any American city."

On 12 April 1961, Yuriy Gagarin made his orbital flight, which radically changed the nature of the space program in the United States. By 25 May, President John F. Kennedy, in his address to Congress, which was broadcast via television to the entire country, announced a new program that was to demonstrate to the entire world the technological capabilities of the United States and its resolve to use them.

KHOZIN: I still doubt that the United States had no desire whatsoever to be the first in space. When he was chairman of the subcommittee on military readiness of the Senate Armed Services Committee, L. Johnson declared the following in January 1958, in his report on the results of an investigation of the launch of the Soviet satellite: "We began the investigation with a simple, but revolutionary fact. The first satellite ever created by man was launched into near-Earth space.... We thought that we would be the first to launch the satellite. But in fact, we weren't even the second."

LOGSDON: Although the space programs of both countries were for a long time heavily dependent on the political relations between our governments, there is a multitude of evidence that the American presidents of the past had not regarded such a state of affairs immutable. Individuals as different as John Kennedy and Richard Nixon felt that space could be the bridge that would lead to mutual understanding between the superpowers.

Here are a few little-known facts. On 20 September 1963, President John Kennedy, in his address to the U.N. General Assembly, raised this question: "Why must the first flight of a man to the Moon be the subject of a competition between individual countries? Without a doubt, we need to figure out why the scientists and astronauts of our two countries—in essence, of all mankind—cannot consolidate their efforts in the exploration of space." Some may remember that address, but certainly not many people know that on 12 November 1963, eleven days before he was killed, President Kennedy, in acting on his address to the U.N., signed a National Security Council directive that proposed a serious study of the possibility of expanding cooperation between the USSR and the United States, to include the study of the Moon.

That document—Memorandum on Actions in National Security No 271—was only recently declassified. Before that and other similar documents were made public, the general public saw J. Kennedy's calls for cooperation as merely a propaganda trick. However, as is now clear, in the period after the peaceful resolution of the Cuban missile crisis and the signing of the Treaty on the Ban of Nuclear Testing in the Atmosphere, in Space, or Underwater, the president felt that cooperation in space was preferable to rivalry.

J. Kennedy's proposal became the culmination point in his multifaceted contacts with Nikita Khrushchev. On

21 February 1962, in a telegram to the American president, the Soviet leader declared the following: "One would hope that the genius of man, successfully penetrating the reaches of the Universe, will be able to find a way to different world and to the prosperity of all peoples on our planet Earth...."

In a letter dated 7 March 1962, J. Kennedy proposed to Khrushchev that the efforts of the United States and the USSR be combined in areas such as weather observation, space-vehicle tracking, space-based communications, and space medicine.

KHOZIN: The Soviet space program was implemented under the roof of the command-administrative system, for which it was a show of force to the outside enemy, a feed trough for the military-industrial complex, a symbol of the greatness of socialism, and, alas, least of all, an area of scientific-technical progress called upon to serve society.

In the United States, the space sector showed itself to be a "servant of two masters"—the defense department and civilian agencies. The militarization of the American space program broke all records. And the Republican administration of R. Reagan took dangerous steps on that path, such as the promotion and execution of the "Strategic Defense Initiative," which aims to create new types of space-based weapons. I also note that now, thanks to the proposal by Russian president B. N. Yeltsin, there is now hope that a joint system of defense will be created on the basis of SDI.

I think that if the reports about the launch of the first Soviet satellites and about the first flights of cosmonauts had not contained quite so many cutting words about the advantages of socialism, which had left the United States far behind (of course, the question must be raised about whether such was, in fact, true), the space paths of the two countries wouldn't have diverged so radically. If the politburo and the secretariat of the CPSS Central Committee and the USSR Council of Ministers Military-Industrial Committee had thought about the material and personnel resources that were being taken from the people and were being placed in the service of the military, with complete disregard for the criteria of effectiveness and profitability, when military space hardware was being considered, the number of launches from Soviet space launch facilities for the defense ministry would hardly have been so unacceptably high.

LOGSDON: The new, 1987 Soviet-American agreement on cooperation in space outlined joint work on a relatively modest scale, but the collaboration has grown steadily. Coordination in the study of the Earth from space was called for by an agreement reached during the meeting of presidents R. Reagan and M. S. Gorbachev in December 1987, but at the Moscow summit meeting in 1988, both leaders gave the go-ahead to an exchange of scientists and to the installation of the science gear of one side on the space vehicles of the other side. During those meetings, President Gorbachev proposed a joint manned mission to Mars. Although the leaders of the two states did not reach an agreement on that issue, they did agree that the two sides should independently study the possibilities of closer cooperation in the matter of exploring the solar system.

In 1989, the United States agreed to the installation of a Soviet receiver on the American Mars Observer craft. The device is designed to receive data from a balloon that is to be delivered by one of your space vehicles to the surface of the planet in this decade. That will make it possible to transmit back to Earth more information, which will be processed by scientists of many of the world's countries.

Yet another remarkable event in the sphere of Soviet-American cooperation is the purchase by the United States of an onboard nuclear reactor for space vehicles, manufactured by your country and known as Topaz. Without such power sources, long-duration missions to the Moon and Mars would be impossible. A multitude of bureaucratic delays slowed the American program for the development of such a reactor. Scientists felt that the acquisition of such a unit would be a good solution to the problem, but no one, of course, anticipated that your government would agree to the sale of systems having such an obvious military application (Topaz had been used as an onboard power source for military satellites for observing the World Ocean).

KHOZIN: Cooperation will not produce the desired results if the atmosphere is not favorable in terms of the relations between our two countries, and it is a function largely of the internal political situation. If the political process in the United States is stable and has continuity, the revolutionary events in Russia and in the former Union in general are producing an ambiguous effect on the realization of national and international space projects that our state is carrying out or plans to carry out.

NASA Award of Contract to NPO Energiya Reported

927Q0204 Moscow NEZAVISIMAYA GAZETA in Russian 23 Jul 92 p 6

[Article by Anatoliy Zak, under the rubric "Cooperation": "Russian Space Agency and NASA Begin Joint Project: Domestic Equipment Will Be Part of the American Program"]

[Text] The period of intense rivalry between Russia and the United States in space looks to be ending. For the first time, signs have appeared of the integration of the two space programs in the most expensive and complex area—manned flights. The longtime opponents have decided to forget their ambitions and combine their efforts.

The position of the Russian space firms is well known today, but in successful America in recent years, NASA bosses have often taken a dim view. Suffice it to say, the main pride and hope of the American space program—the permanent space station Freedom project—has several times already been on the brink of being stricken from the state budget, which is creaking under the weight of economic problems and a gigantic deficit. To keep the spending on Freedom within an acceptable $30 billion,

NASA has already "pared" several solar panels from the station and shortened it living quarters and laboratory module. Another way to save money was to bring foreign partners into the program. Japan and the countries of the European Space Agency, for example, have taken it upon themselves to build two science modules, and Canada has assumed responsibility for developing multi-armed manipulators for the assembly operations on the station. All parties, of course, have the right to use the orbital base for their purposes.

The gigantic project, however, still had one weak spot, which made the American space agency uneasy—the so-called assured crew return craft, for emergency departure of the Freedom crew back to Earth during periods when the Shuttle spaceplane was not moored to the station. After going through a multitude of alternatives, NASA was unable to settle on any of them—some cost too much, others would take too long to develop. And that's when our renowned NPO Energiya came to the rescue, proposing that the relatively simple, inexpensive Soyuz spacecraft—which has been rolled out for many years in the Soviet manned space system—as a rescue craft for Freedom.

After three months of talks, Yuriy Koptev, the director of the Russian Space Agency, and Daniel Goldin, the director of NASA, ratified the first contract between NASA and NPO Energiya, on 18 June of this year. The chief aim of the contract is to study the possible use of Russian space equipment in the Freedom project. Such a turn of events is, without a doubt, a good sign for the 30,000 staff members at our main space firm, which is located near Moscow, in Kaliningrad.

In the initial period of the agreement (it will last one year), $1 million will be spent on research in three areas. First of all, specialists evaluate the advisability of the use of the manned Soyuz TM spacecraft and the unmanned Progress resupply craft in the project for the permanent American orbital station. In addition, the characteristics of our automatic docking system, which is unprecedented in its reliability and could become the basis for standardizing all the world's space docking equipment, will be studied. Finally, another area NASA is interested in involves Russia's unique experience in biomedical support of long and ultralong space missions.

By the beginning of the 21st century, the first line of the space station Freedom with a permanent crew consisting of four individuals will move into operation. Its huge, 100-meter-long structure will be assembled by teams of space shuttles and will ultimately represent a unique symbiosis of the higher technical achievements of the entire world.

Large-Scale International Cooperation Urged for Creation of New Space Launcher System

927Q0229A Moscow ROSSIYSKAYA GAZETA in Russian 9 Sep 92 p 3

[Article by Vitaliy Katayev, first deputy director, Service for Advising the President of the Russian Federation on Conversion Matters: "All Europe is Constructing an 'Elevator' Into Space"; the first two paragraphs are an introduction]

[Text] In September a conference of members of the European Community and major European companies will be held in Brussels for examining the problems and prospects for cooperation with Russia in the aerospace field.

Russia is, so to speak, at this conference. The possibilities of our scientists and specialists in space technologies can make a weighty contribution to the European, and not only the European, potential. So that the mutual advantage of cooperation causes no doubts.

Something else is evident: our proposals must be in the channel of integration processes in Europe directed to the strengthening of military safety and improvement in ecological conditions. The businessmen of Europe could be asked the question outright: is it not time to transform space into a zone for solving urgent problems of mankind not by single launchings, but by means of a constant presence? But this necessitates a simple "elevator" into space—a transport system satisfying the numerous and at times contradictory requirements of today and tomorrow.

Neither the Space Shuttle nor the Buran can in any way be called multitime-use ships. And is it possible today to construct a space carrier which would be for multitime use to such an extent that not a bolt would be lost, which would be ecological like a "kitchen combine," and for which the cost of putting a kilogram of freight into orbit would not exceed 100 dollars (in contrast to the present-day 7000 dollars)?... Specialists feel that this is possible by combining efforts and reexamining planning priorities.

Some idea concerning the main difficulty is given by the hackneyed anecdote of a bed workshop at a "defense" enterprise: however much they tried to assemble a bed all they turned out was a machine gun. Something similar also is observed in the approach to space transport systems. In this field planning and development work is being carried out by both aviators and rocket specialists. And in our country and abroad many new ideas have accumulated. But here's the unlucky thing: for aviators for one reason or another it is mostly a superaircraft with a horizontal takeoff and propulsion in the atmosphere which is proposed, whereas the rocket specialists propose a rocket which in the best case has wings.

Stereotypes are ruining the idea of developing a space transport vehicle truly suited for multitime use and corresponding to the times and the future. Moreover, there is not always justification for the hairsplitting of the designers with respect to the energetics of the system: they are striving to save fuel at any price. But, indeed, even today a good number of technologies have been developed and it is possible to cast aside former approaches. In addition, new phenomena are coming to the forefront making it necessary to make an intensive search, especially in Russia, for completely new space economy concepts.

Cosmonautics in our country, in contrast, for example, to American or French ("sea") variants, is, if it can be expressed in such a way, "land based." During rocket launchings tens of tons of metal, expended in their particular segment of the trajectory, are strewn onto the landscape. This metal, in addition, is flavored with a "sauce" of carcinogenic fuel remnants. And enormous areas of test ranges and "fallout fields" are alienated for such "gifts" to the environment. Our cosmodromes Baykonur, Plesetsk and Kapustin Yar have removed from economic use almost 18 million hectares of land (of which 4.5 million hectares are in Kazakhstan).

For the time being the government has not had to pay for these hectares, which are dangerous for habitation. However, it can be expected that in a market economy with its sharply increasing regional interests, even in the immediate future it will be necessary to pay for the alienated land. Russian cosmonautics has become dependent on unaccustomed economic factors. The "land variant" of basing of spaceports may become so expensive that Russian space programs simply will not be able to bear the cost.

This means, I repeat again, that it is necessary to develop work on a fundamentally new transport system and to change the basis for approaching this problem. With our lack of money? With the poverty of today's space program? To be precise, space is poor due to the fact that even the modest sums allocated for space exploitation are being expended with the wastefulness of a rich spendthrift. Now in the CIS there is standard production of six major single-use boosters. Last year we carried out 62 launchings (in the United States—18, in France—eight). And for each there is payment in full for both the rocket and support. Rockets with a cost of tens of millions of rubles disappear virtually without a trace. What would you say if railroad cars after being unloaded in the Far East sank in the Pacific Ocean? What is this folly? But such folly is repeated time after time in each space launching.

A transport system of a truly multiple use character could look approximately as follows. Its elements must be completely multiple-use. The simplicity of its operation should be at the airline level. The cost of a kilogram of freight lifted into space should be in the ballpark of 100 dollars. Crew safety must provide for in-depth backup for reliability in execution of the mission. There must be ecological cleanness. There must be a capability for carrying a wide range of loads from 0 to 50 tons. And so forth, including the possibility of a vertical launch with simple launching facilities and the possibility of horizontal ("aircraft") landing at ordinary civil airports.

From these conceptual requirements there follows a chain of technical specifications of the system and its elements. For example, a launching weight up 2000 tons, two stages of the aircraft type—propulsion and space, landing weight of manned aircraft—200-250 tons each. With respect to fuel. The principal concern of a designer has always been to obtain the energetically most powerful fuel and to use it efficiently. The economic expenditures, to be sure, must not be lost from sight even in this case, but optimization of the system must first be carried out relative to operational parameters. Therefore it is proposed that "passengers" be transported into space, as well as aircraft chassis and engines for maneuvering in the atmosphere and means for the rescue of a crew. These planning freedoms must be paid for by one thing: a certain quantity of fuel.

In such a case the fuel should be cheaper than any existing in nature. It exists. It also is ecological and for the time being its supplies are great. This is an "oxygen-propane" fuel mixture. The latter in the old prices was cheaper by a factor of 400-500 than hydrogen and does not require either complex protection against instability or complex protection against heat. American developers already almost a decade ago demonstrated that the launching weight of an oxygen-propane system is less than that of a similar system based on oxygen and hydrogen by 20%. A propane system also worked for the Americans. Moreover, our engine specialists at the Moscow, Dnepropetrovsk and Voronezh design bureaus for two decades have already been talking about propane, but they fear the soot forming during combustion of the mixture. And nothing is being done for moving forward a clean engine of an optimum size. And thereby its future is being destroyed.

To be sure, the problem of a universal space transport covering the entire range of requirements will not be solved at once. This means that classes of small and ultralarge carriers will have a reason for existence for some time to come. Proceeding on the basis of the existing weight of communication, television and surveillance satellites, space factory and research space vehicles, it is possible to define a transport "triad": low weight—0.1-0.5-4 tons, intermediate weight—0-40-50 tons and heavy weight—more than 100 tons.

Satellites in the low category can be put into orbit by systems which as the propulsion stage use rocket or aircraft launchers, such as our An-224 or Tu-160 aircraft. In the West such systems are being developed in the form of the Saenger, Hermes, Pegasus and a number of other projects. Unique launchings of objects weighing 100 or more tons in the interests of mankind can be carried out using the one-time usable Buran booster, although its reliability for the time being is under question.

However, the least expensive and most operable should be the heavy range, whose role includes all work on delivery into orbit, repair in orbit and removal from orbit of objects which should be created with allowance for the possibility of such servicing and be compatible with the elements of the mass transport system.

In my opinion it should be created only on an international cooperative basis, for which the organization of an international consortium, let's say, is possible.

Without question the European countries can develop it independently. But it would be more productive to solve this problem by using the technological advances of other well-developed countries. The European Economic Community has already adopted a decision on the financing of work and research in the aerospace field. Russia, in our opinion, should participate in this work as an equal.

But our participation must be well thought out. It is inadmissible that the country be discredited by ill-conceived ideas and empty proposals—tens of volumes of these ideas and proposals have been accumulated in the Soviet space archives. A joint major project, and specifically a general-use transport system, is worthy of examination in such a serious forum.

International cooperation in its realization could look as follows. The United States and Russia would work on a thrust engine operating on an "oxygen-propane" fuel mixture. An aerial-jet maneuvering engine (operating on propane) would be the concern of the United States. Russia and Ukraine would take on the responsibility for a rocket module for autonomous operation. Development of a system for rescuing crews would be delegated to Russia. Propulsion and space aircraft would be developed in Great Britain and France. The control system and analytic onboard systems would be developed in Japan. The system for the docking of aircraft under orbital flight conditions would be the task of China and Russia. A launching module, including automatic docking of propulsion and space aircraft, would be developed in Germany. A system for gas supply, gas purification and high-speed fueling of aircraft before takeoff would be developed by the Czechs and Slovaks.

It is not superfluous to mention that inexpensive and universal international transport services for the delivery of payloads into space and their return from space and the possibilities of space repair will reveal the true intents of countries in rocket construction and will lessen motivation for construction of their own ships. Questionable actions and mutual accusations with respect to the spread of rocket technologies will cease. The missile danger for mankind is being considerably lessened.

This would be still another step toward safety and peace in the world.

U.S., Russian Plans for Study of Mars

927Q0230 Moscow RADIKAL in Russian
No 33, Sep 92 p 9

[Article by Petr Deynichenko: "The Mars Decade"; first paragraph is source introduction]

[Text] **The launch of the American spacecraft to Mars in mid-September will open a decade of intense research of that planet by the United States, Russia, Europe, and Japan—if, of course, finances allow it. In the words of the director of the American space program, Daniel Goldin, "as a result of that huge program, the flight of astronauts to Mars will take place as early as the beginning of the next century."**

Scientists today are faced with a number of questions whose answers will help to carve the path for the future manned mission and, as specialists hope, will lead to a better understanding of the problems of the environment on Earth and on Mars. The most important of those questions are these: Was there ever any life on Mars? Is there water there now? What are the seasonal variations of weather there?

The United States and the USSR in the past sent space vehicles to Mars, but the research came to a halt in the 1970s. In the mid-1980s, a Soviet mission to the planet ended in failure. So, big gaps remained in our knowledge of the Red Planet.

The first spacecraft to depart for Mars will be the Mars Observer. It will be launched September 16, from Cape Canaveral, with a Titan 3 rocket. The spacecraft will lay the foundation for all subsequent missions, and it will perform global mapping of the Martian surface. The instruments carried aboard the Observer will make it possible to produce images with a resolution that is 40 times better than that of previous images. One will be able to distinguish on the photographs details that are about 10 meters across—large boulders, for example. Wesley Huntress, director of NASA's solar system exploration division, has reported that those operations will get under way in mid-December 1993.

The spacecraft will be placed in a circumpolar orbit around Mars and will remain in that orbit for half a Martian year—687 days—completing one revolution every 118 minutes. That will enable it to record changes that take place on the planet over the span of all four seasons. On the basis of images of the planet's surface made from an altitude of 250 miles, scientists hope to create a daily weather map similar to those compiles by meteorologists here on Earth. Thus, the Observer will become the first weather satellite for Mars.

At the end of its mission, the Observer will take part in the Russian Mars project. Our unmanned probe will be launched soon after Observer—it will deliver a robot-rover to the planet in 1994. The robot will be capable of climbing hills and getting over boulders. The complex is expected to be equipped with a balloon that will raise science instruments above the planet to study the atmosphere. France, Germany, and Hungary have invested money in the Russian mission.

Robots and other automatons that will be delivered to Mars by the end of the current decade should study the geological and meteorological conditions of Mars, as well as its seismic activity. Among them are 16 NASA robots, some of which will be launched in 1996, the others, in 1999. There may be robot-rovers among them. The aim of the project is to study the Martian environment.

Those plans will require colossal amounts of spending. The Mars Observer mission alone, according to estimates, will cost $900 million. At the Eighth Planetary Congress of the Association of Space Research in Washington, M. Griffin, the director of the NASA research program, reported that NASA is still not ready to announce the total cost of the program for the exploration of Mars. In the meantime, prominent astronomer Carl Sagan also stated at the congress that the expected cost of the mission to Mars would be nearly $1 trillion over the course of two decades. Only international cooperation, he added, will be able to bring that sum to an acceptable level, which many American congressmen still consider to be unacceptable. In Sagan's words: "From the standpoint of finances and frames of mind on the question, the situation is such that either we fly to Mars together, or we don't fly there at all."

The program also has difficulties of a technical nature. In the words of the already cited M. Griffin, the United States is planning to use the Moon as an intermediate station for the flight to Mars. That will require building there a permanent or at least a long-term base. Moreover, there are not yet launchers powerful enough for the manned mission—the weight of the spacecraft will exceed 230 tons—although the technology for creating such launchers exists in Russia and in the United States.

Still, all those problems will hardly stop the new "space race." Competitors who are clearly weaker are ready to join the exploration of Mars. The European Space Agency, for example, plans to send up its own mobile station with one of the American spacecraft, and the Japanese space agency, in turn, intends to launch a vehicle in 1996 for studying the upper atmosphere of Mars and the effect that solar wind has on it.

Will Mars become the same dream for today's generation of space researchers that the Moon was for the generation of the '60s?

U.S.-Russian Plans for Joint Manned Flights Called Unfair to Russia

937Q0005 Moscow IZVESTIYA in Russian 19 May 92 Morning Edition pp 1, 8

[Article by Sergey Leskov: "America and Russian Have Signed an Agreement, But They Don't Know How They Will Finance It"; first paragraph is source introduction]

[Text] **In accordance with an understanding reached by the presidents of Russia and the United States, an agreement has been signed in Moscow by RSA director Yu. Koptev and NASA director D. Goldin concerning cooperation in the field of manned missions and concerning a program for the study of Mars.**

The first stage of the agreement calls for a weeklong flight by a Russian cosmonaut aboard the American Space Shuttle in November 1993. Two candidates for that were chosen from among many at the Cosmonaut Training Center—Vladimir Titov and Sergey Krikalev. Titov has been in space twice, and he spent a whole year in orbit in the course of his second mission. An incredible number of all sorts of adversities came his way, more so than with anyone else, and he always performed admirably, by the way. Right now, Col V. Titov is working as deputy chief of the administration for training at the Cosmonaut Training Center, and the experience of the American astronauts is also important for him from the standpoint of a specialist.

Sergey Krikalev is working at the NPO Energiya, and he, too, has been aloft twice, touching down just this year from the second mission. S. Krikalev, who is only 34, is regarded as one of the most skilled and, if such an epithet is allowed in his profession, talented of our cosmonauts. As early as this month of October, V. Titov and S. Krikalev—who, by the way, have a pretty good command of English—will travel to the Johnson Center in Texas.

The next stage is planned for 1994-1995. An American astronaut will fly aboard a Soyuz TM with our cosmonauts to the Mir station and will work there for three months. He will make his return, however, aboard his own Space Shuttle, which will dock for the first time ever with a Russian orbital station. At the same time, the Shuttle can deliver the next crew of our cosmonauts to Mir.

Next to those effective programs, the relatively modest project for the study of Mars could get lost. In 1994, two American instruments will be mounted on a Russian vehicle that will descend to the surface of the planet. For all its modest appearances, that project makes a breach in the COCOM constraints, thanks to which NASA, for the first time ever, officially entered into a technology-related collaboration with Russia. While the excursion of the American instruments is expected to be for free, it is possible that, according to Babakin Scientific Research Center director R. Kremnev, the collaboration will expand and NASA will provide material support for the mission.

In any case, the funding of the manned missions must be considerably greater. In light of the planned construction of the American space station Freedom, the lengthy stay of astronauts aboard the only space complex in the world will give NASA invaluable experience. At the same time, what we get from the flight of a cosmonaut aboard the Shuttle is questionable—after all, the program for reusable space planes is virtually frozen in Russia. From a technical standpoint, the exchange will hardly be equal, and special meaning attaches to the possible material benefits to our space program, which has tightened its belt. Today, they feel at NPO Energiya that our "contribution" is much greater than that of the Americans. NASA doesn't share that opinion. Nobody today knows how to reach a common denominator when there's no way to compare wages or the costs of operations, materials, and fuel. By all appearances, the working group for implementing the agreement will have to break a lot of stereotypes.

Is there something humiliating about the fact that even before the flight into open space, conversations are being held about something as crude as money? No. That's,

above all, a practical matter. But something else is humiliating, and that's the fact that without agreeing beforehand on a firm price, we practically gave the English cosmonaut a free ride in space. Let us recall that the understanding between the presidents of Russian and the United States spoke of an "equal exchange" in the field of manned missions.

President of Kazakh Academy of Sciences Advocates Cooperation With U.S., Work on Mars Flight

927Q0214 Moscow POISK in Russian
No 26, 20-26 Jun 92 p 3

[Interview with Umirzak Makhmutovich Sultangazin, president of Kazakh Academy of Sciences, by Svetlana Krymova, in Alma-Ata, under the rubric "Discovering America": "Next Stop—Mars"; first paragraph is source introduction]

[Text] **For the first time in the history of independent Kazakhstan, the president of the republic, Nursultan Nazarbayev, recently spent some time in the United States on an official visit. Among the topics that were discussed during talks were issues associated with scientific cooperation between the two countries. We asked Umirzaka Sultangazin, the president of the Kazakh Academy of Sciences, to tell us about that.**

SULTANGAZIN: The science program began with a visit to the National Aeronautics and Space Administration. As you know, the Baykonur space launch facility has gone over to the jurisdiction of Kazakhstan, and we have created a space research agency and an institute with a similar name as part of the academy of sciences. All that requires a study of worldwide experience in the administration of that sector and in the organization of scientific research.

They acquainted us with the activities of NASA and with its structure. I, in turn, told them about the directions our work is taking. We discussed especially the prospects of joint research.

A priority area here will be the study of Earth from space. In the United States, there is a program called "Global Changes," in which our specialists will participate.

POISK: Will Kazakhstan be able to be an equal partner with the United States?

SULTANGAZIN: A complex of factors must be considered to make that kind of statement. A decisive factor is the transfer of the Baykonur facility to the jurisdiction of our country. Of no small importance is also the fact that we have maintained our ties with the largest science centers in the Russian Federation and in other states of the former Union. I feel that the opening of the space research institute also plays a role. Finally, we have our own original developments. All that forces the Americans to consider us equal partners. But, without a doubt, collaboration with NASA will raise the level of research. Carrying out the project will enable scientists of the planet to keep their fingers on the pulse of the Earth. Kazakhstan will come out ahead on two fronts: it will be able to make a weighty contribution to the entire affair, and it will receive a rich store of reliable information on the state of the environment within its borders.

And in the future, there will be joint studies of deep space. Until now, we have studied the planets with ground observatories. But now the opportunity is arising to study them with space-based systems—we will be able to place gear on orbital stations. That will be of immense significance for the development of basic science. The program for the preparation for a joint mission to Mars will also move onto a practical plane. We spoke about that in detail with a Mr. Broumly, an aide to the president on science and technology affairs.

But primarily raised the question with him about the creation of joint scientific-technical centers. It would be mutually beneficial, for example, to create a center for producing semiconductor materials. The rapid growth of information science and communications systems requires ever-expanding production of electronics, and that is impossible without semiconductor materials.

I proposed this to the Americans: your investments, our technology for refining the wastes of the phosphorus industry (the academy's Physical-Technical Institute is involved in that), and our resources. Together we can create a powerful scientific-technical center. They showed interest in the proposal.

A second important topic of conversation with Broumly was the joint peaceful use of the scientific-technical potential of the former Semipalatinsk Nuclear Testing Grounds. That, by the way, is directly linked to the problem of preparing a mission to Mars. The fact is that leading scientists of the former Union have developed a prototype a nuclear rocket engine. Our American colleagues are also working in that area. We could combine efforts and use the potential of the testing grounds to make improvements on the engine. That proposal was reported to President Bush.

POISK: What other things were discussed in the talks?

SULTANGAZIN: We are hoping for cooperation in the training of science cadres. When I first went to the United States in the late 1970s, I met quite a few Chinese undergraduate and graduate students. Back then, literally tens of thousands were being sent abroad for study. Now China has a large corps of first-class specialists who are rather successfully carrying out reforms in their homeland.

In America, there is a special fund for training and retraining scientists and specialists of the former USSR in American universities and laboratories. Specialists are trained in applied mathematics, statistics, control theory, computer technology, aeronautics, and many other areas.

During the talks, it came out that our American colleagues have science-related interests in Kazakhstan. In addition to the above-mentioned nuclear rocket engines and certain developments in the field of mathematics, they are also attracted by, in particular, our astrophysical observatories, botanical gardens, and the rich flora and fauna of Kazakhstan. We intend to give them every possible assistance, and we will go to our government on that score in the near future. By the way, several of our foreign colleagues expressed dissatisfaction in the talks with the passive position taken by the Bush administration on aid to the countries of the Commonwealth. They feel that the administration should act on a larger scale and more promptly. I think that substantial shifts should take place in the area of scientific cooperation and training of personnel by this fall.

POISK: Umirzak Makhmutovich, while the official delegation of Kazakhstan was in the United States, there was some noise raised in the newspapers about "the change in Kazakhstan's nuclear position being too abrupt." What do you say about that?

SULTANGAZIN: The noise is raised by those who do not want to understand that Kazakhstan is in the process of learning what its own role in the world is. I must stress, it's a process! We are encountering things that are new for us and that are forcing us to rethink certain things and consider various sides of questions. Let's imagine that Kazakhstan announces itself a nonnuclear power. And then what? We would be alone to handle the problem of our security among nuclear states.

But now, as one among equal parties, Kazakhstan is taking part in disarmament talks in which its interests will also be taken into consideration. I'll say this much: Kazakhstan's positions are not changing, but they're being refined.

Director of Ukrainian Space Agency Interviewed

927Q0216 Kiev VECHERNIY KIYEV in Russian
6 Aug 92 p 2

[Interview with Vladimir Pavlovich Gorbulin, director of the Ukrainian National Space Agency, by VECHERNIY KIYEV correspondent Lyudmila Stukalina, under the rubric "Timely Topic": "Does a Country That Doesn't Have Enough Sugar Need Rockets?"; first paragraph is source introduction]

[Text] **The conversation between the VECHERNIY KIYEV correspondent and the director of the Ukrainian National Space Agency, Vladimir Pavlovich Gorbulin, began with [the] question, Does a country that doesn't have enough sugar need rockets?**

GORBULIN: Your question is a natural one, because today the training of a cosmonaut for a flight aboard a Soyuz costs $11 million. To show our respect for space, therefore, we need immense sums that we don't have.

VECHERNIY KIYEV: What do we have?

GORBULIN: Ukraine has a rather solid potential in the rocket-space sector that enables us to manufacture launch vehicles, space vehicles, and various kinds of hardware used for basic research and for applied purposes. We got a fairly good inheritance from the former Union, and Ukraine—as the birthplace of the Kosmos and Interkosmos satellites and the Tsiklon and Zenit launch vehicles—rightfully entered the world community of space countries, i.e., the United States, England, Russia, Japan, India, and China.

Today, there are two points of view on the matter. The adherents to the first point of view consider Ukraine a space power and demand demonstrations of immediate successes. Proponents of the second, on the other hand, are convinced that we are tied to Russia and that we shouldn't doom ourselves to independence. I can say that it would be difficult for us without Russia, just as it would be difficult for Russia without us. So it would be senseless for Ukraine to sever the ties, but we must search out our own worth.

VECHERNIY KIYEV: And what will that be?

GORBULIN: The rocket-space sector has always worked for defense and, in that regard, was a yoke around the neck of the national economy. But we must keep in mind that all that is the very newest, most advanced is concentrated in the achievements of that very sector, and we must preserve it. Not for military needs—they have to be kept to a sensible minimum—but primarily for the needs of the national economy, economics, to which it could give a great deal that is beneficial. And thus, the capability of maintaining the sector arises, for the spending is paid back a hundredfold. I'm not going to hide the fact that we are devoting a great deal of attention to questions of military space and control of space arms. And yet, the main thing is to re-gear the sector to civilian needs. I'll mentioned only the principal areas of the programs and projects. The first is communications and telecommunications in the country. Work is under way on the project involving the space vehicle Okean, for the study of the ocean depths, in which the highly sensitive equipment developed in Kharkov will be used. "Warning" is what we call a complex of works involving the forecasting of natural disasters with space-based hardware.

We have proposed to the UN Committee for the Peaceful Use of Space our own version of the use of SS-18 strategic missiles as launch vehicles that loft satellite-laboratories into orbit. Those space-based laboratories would become producers of pure medicinal preparations and extremely valuable metals that couldn't be produced on the ground. Geology and forest management, natural resources management and land use, agriculture and ecology. It's hard to name a sector to which the use of space-based hardware wouldn't be of benefit.

VECHERNIY KIYEV: We first moved out of the shadow of the former Union on 16 June 1992, when you

represented our power to the world community as a possible partner with a rather solid potential in the rocket-space sector.

GORBULIN: I gave an address at the 35th session of the UN Committee for the Peaceful Use of Space, and I presented my vision of the use of space for the broadest of purposes. We had been members of that organization for a year already, but that was the first time we presented a detailed program. For the trip to America, we prepared a number of serious technical projects involving, primarily, basic research, to include the study of near-Earth space, the Sun, and deep space—as well as applied areas—plus, finally, a complex of objectives involving the development of space hardware. That is where the creation of new types of launch vehicles and space vehicles belongs.

Space is an international sector, which is why it is realistic to speak of an integrated program for the exploration of it jointly with other countries. We have, say, the Zenit launch vehicle, with which we can enter into cooperation with a country that has a space launch facility. We need to arrange our relations in such a manner that they are beneficial to Ukraine and other participating powers, and not just Russia or Kazakhstan.

In the field of space research, the entire world is traveling the route of integration of efforts. That is of primarily economic benefit. One country alone cannot execute large-scale research, its technical and economic potential simply cannot withstand that. To be a space power is incredibly difficult, and only the United States and the former Union were able to be space powers.

VECHERNIY KIYEV: The [Ukrainian National Space] Agency is a state structure—

GORBULIN: For the time being, no money from the state budget has been appropriated in any of the CIS countries (with the exception of Russia). This year, we are seeking support in the Committee for Science and Technology, in the Ministry of Defense, and in the Ministry of Machinebuilding, Military-Industrial Complex, and Conversion.

There are two routes for development. The first is to attract commercial structures. The Americans have long been taking that route: individual companies become monopolistic holders of information obtained by communication satellites. We, too, are engaged in a search for commercial structures and international investors. The proposals I took with me to America evoked some amount of interest in American business circles.

VECHERNIY KIYEV: The Agency is still not formed structurally?

GORBULIN: My trip to New York gave me the idea that we will need more than just narrow specialists in the new agency. We are planning to create sections for international cooperation, legal affairs, and future programs and marketing.

VECHERNIY KIYEV: Allow me to ask, but are you comfortable in your new post? As far as I know, you worked for some time in the apparatus of the Central Committee of the Ukrainian Communist Party?

GORBULIN: I'm happy to have the appointment. I'm an engineer by specialty, and I worked many years in a design bureau, taking part in the creation of the Kosmos space vehicles and then in the development of strategic missile systems. I defended my candidate's dissertation. They invited me to the apparatus of the Central Committee of the Ukrainian Communist Party, where I was head of the sector for rocket-space and aviation technology. So even though I was a party bureaucrat, I was engaged specifically in my own field. I took part in the organization of all the programs involving the creation of rocket-space hardware in Ukraine.

VECHERNIY KIYEV: You're a USSR State Prize laureate, and also a member of the Union of Journalists of Ukraine?

GORBULIN: I've written a book about space. I may write a second book. The right of first publication, I think, will be with VECHERKA.

Director of Azerbaijan National Aerospace Agency Interviewed

927Q0232 Moscow ROSSIYSKAYA GAZETA in Russian 16 Sep 92 p 6

[Interview with Prof. A. Sh. Mekhtiyev, director of the Azerbaijan National Aerospace Agency (ANAKA), by Svetlana Semenova, in Baku: "Azerbaijan Has Its Own Space Program"; first paragraph is source introduction]

[Text] **This year, what was formerly the Scientific Production Association for Space Research was transformed by presidential ukase into the Azerbaijan National Aerospace Agency. We had a conversation with the director of ANAKA, Prof. A. Sh. Mekhtiyev.**

MEKHTIYEV: Everything got under way after the congress of IAF (International Astronautical Federation) that was held in Baku in 1973. It was then that a group of enthusiasts headed by Academician T. K. Ismaylov created a scientific organization that later came to be called the NPO [Scientific Production Association] for Space Research. We participated in national space programs and projects. With the break up of the USSR and the attainment of sovereignty, Azerbaijan needed to effect its own independent policy in the field of space research.

In developing our own space program, we started with the fact that it must provide tangible benefits to the economy of Azerbaijan and must be feasible with our own resources, i.e., on the basis of the existing level of scientific-technical development and sensible material and financial expenditures.

One of the most essential program goals involves the space-based environmental monitoring of the territory of Azerbaijan, for which we expect to create a network of receiving stations, and the processing and interpretation of aerial and space-derived information, with its delivery to the consumer.

After all, we have catastrophic ecological problems in a number of regions. The industrial areas in the cities of Baku, Gyandzhi, and Sumgait have been declared disaster areas. The Caspian Sea area and the river system are calling for help. Regional land use is in disarray, and there's no monitoring being done of the condition of our forests and pastures.

ROSSIYSKAYA GAZETA: Does Azerbaijan have the resources to implement the program?

MEKHTIYEV: The fact of the matter is that we're not setting out to create rocket-space hardware or to put our own satellites into orbit. But we are in a position to finish what we started earlier in terms of developments involving the creation of onboard gear designed for remote sensing of the Earth and astrophysical research. That will not require substantial financial means from the republic's budget.

But space-derived information can be systematically received by radio link from Russian, American, and French satellites. New foreign systems of space-based observation are expected to be introduced in the future. We hope that by then we will also be ready to received that truly invaluable information and process it in the required volumes and at the required rates.

ROSSIYSKAYA GAZETA: Does that mean that collaboration with our colleagues from the Commonwealth countries, particularly Russia, is expected?

MEKHTIYEV: Absolutely. After all, the definition of "our own independent policy" is arbitrary. That policy calls for, as I already mentioned, the solution first of all of our regional problems. The means for achieving our goals are determined by available technical possibilities and cannot be exhausted by the potential of just one country. In that sense, there can be no independence, of course, because all the participants of the former alliance in space are linked to one another by the logic of technical progress. We set up our "universities" in many large science centers of the former Union. We were given all kinds of help in setting them up and building them up. And that involved not just the fact that almost all our work was financed from the center. The help was considerably broader: scientific-technical help, help in training personnel, and help in developing a infrastructure for social and living conditions.

Rending those ties today would mean halting for a time the development of space research in Azerbaijan. It's another matter that, before, we were geared only to work within the Union structure. Now we have an opportunity to develop multilateral ties with other space countries of the world and with international space organizations. And we must work on the basis of mutual benefit—after all, we're moving toward a market economy.

Moscow Conference on Aerospace Conversion

927Q0231 Moscow IZVESTIYA in Russian 8 Sep 92 Morning Edition p 5

[Article by Sergey Zemlyanoy: "A New Life for the Aerospace Complex"; first paragraph is source introduction]

[Text] **In the context of a UN initiative supported by other international organizations, Moscow will host one of a series of conferences organized by the UN under the rubric "Evaluation of Technologies in Conversion for Growth." A specific theme with a very precise target is offered for this conference—"Conversion of the Aerospace Complex."**

It is the aerospace sector that is the leader of the entire defense industry, the brain of that industry, and the holder of the most advanced technologies, including those that have a dual application. And it is of some import that—according to the most modest estimates supported, by the way, by many Western experts—Russia not only does not, in that sphere, lag behind the advanced countries, including the United States, as it does in other fields, but actually is ahead of them in the development of a number of areas. It should be noted that in recent years increasingly more experience, specific and beneficial, has been accumulating here in the joint implementation with foreign partners of conversion projects and programs at enterprises of the Russian aerospace sector. Conversion of aerospace technologies could, in a very short period of time, yield significant results not only for Russia, but also for the rest of the world community: take, for example, just the realistic idea of creating a world space system for observing the Earth's surface.

For an organization like the UN, of course, it's important to evaluate the consequences of conversion for solving the problems of international development that have come about. The prospects here are linked not only with the additional resources that are provided by the cut back in military spending, but also with, mainly, the use of technologies of dual application that are concentrated in the military-industrial complex. Irrefragably linked to the transfer of such technologies to developing states is the surmounting of their being "second-" or "third-class" economically and the conflicts caused by that in international relations.

The UN initiative has received the approval of the president of Russia, B. Yeltsin, and appropriate governmental decisions have been made. The international conference "Conversion of the Aerospace Complex" will begin its work on 12 October. Its organizing committee has been formed and is headed by O. Lobovoy, the chairman of the Russian government's Expert Council. Expressed at the first meeting of the committee were calls for a broader exhibition during the conference of

the conversion potential and the developments engendered by the Russian aerospace complex, as well as specific examples of international cooperation along those lines.

Future of Aerospace Plane Technologies Discussed at Moscow Conference

927Q0241 Moscow IZVESTIYA in Russian 26 Sep 92 Morning Edition p 2

[Article by Sergey Leskov: "Buran Still Isn't Flying, And They're Already Looking for a Replacement for It"; first paragraph is source introduction]

[Text] **In Moscow, the First International Aerospace Conference is getting under way. Specialists from around the world will discuss future designs of reusable spacecraft.**

Since November 1988, when the first and only flight of the reusable Buran space plane took place, officials of the space sector have never tired of suggesting to the Soviet people that that vehicle has absorbed the best achievements of science and technology and is absolutely necessary for the study of space. To criticize our "Shuttle" was risky, because it was surrounded by an atmosphere in which biting remarks were regarded as lacking patriotism. Meanwhile, the spending for Buran has already exceeded 20 billion rubles [R] at the old prices.

And here soon will be the fourth anniversary of that amazing Buran sitting on the tarmac, and its second flight has been postponed time and again. The saddest thing is that even if the funds needed for finishing the craft were found, there wouldn't be anything for our shuttle to do in orbit today. The idea itself of a reusable craft is, without a doubt, an advanced idea. But in the space program, there are not yet any payloads of 25-30 tons, and Buran is like a heavy truck racing around the highways without a load.

On the eve of the First International Conference on Reusable Systems, this correspondent went to what is, even today, one of the most secret enterprises of the defense sector, NPO Molniya, and met with the general designer, G. Lozino-Lozinskiy. In Lozino-Lozinskiy's words, plans are that the second flight of Buran really will take place in the second half of 1993, and, again, it will be unmanned. During that flight, it is expected to dock with the Mir station, and the Mir crew will spend a lengthy period, 24 hours, working aboard the space plane. Right now, the craft is at Baykonur and is undergoing tests.

But they've decided now to speak openly about Buran. G. Lozino-Lozinskiy admitted for the first time ever that he built Buran against his own better judgment, under pressure from "above" and, essentially, in pursuit of the American Shuttle. Now the 83-year-old designer is making an attempt to return to his once-rejected proposal and to build a space plane that is smaller than Buran.

Statistics show that in the past five years, 85 percent of all satellites put into orbit have weighed under 10 tons. It is for that kind of payload that space planes are being built in Great Britain (Hotol), Germany (Saenger), and France (Hermes). Even in the United States, the Space Shuttle is coming under fire increasingly more often, and a smaller, single-stage-to-orbit airplane is being developed, with as much as five percent of the NASA budget earmarked for that project.

Russia—or to be more precise, the entire CIS, based on branching cooperation—is in a more favorable position than are the other space powers. The fact is that we have the heavy-duty Mriya aircraft, which is capable of taking a cargo of 250-270 tons aloft, from where a light, reusable craft could be launched. At NPO Molniya, they have just finished the preliminary design for the MAKS system, which is based on that principle. In Lozino-Lozinskiy's opinion, the experience garnered at NPO Molniya makes the creation of a new space plane over a six-year period feasible.

But that takes a lot of money. It's easy to imagine the kinds of attacks that would be leveled at a new, expensive project by other general designers, who would see it as nothing more than an infringement of their share of the meager space budget. The project would be viewed with especial pain at the NPO Energiya, where the superrocket Energiya and many of Buran's systems were developed.

In today's situation, only international cooperation can solve the financial problems. And that possibility is becoming more and more a reality. NPO Molniya has already been approached by the British and the French, who, having run into problems in the development of Hotol and Hermes, are hoping to solve them with our help and our hardware. Questions of international cooperation and plans involving the most advanced areas in reusable space systems will also be discussed at the conference.

But the main question, we have to answer on our own. What do Russia and the CIS (remember, the Mriya is built in Ukraine, and the cosmodrome is in Kazakhstan) need MAKS for? One can hardly agree with the notion that Buran, as its supporters never tire of repeating, embodied the best achievements of science, if the laws of economics, not the last of the sciences, were not taken into consideration during Buran's development. Calculations show that MAKS, putting 10 tons into orbit, will be profitable at 30 launches a year. That far exceeds the needs of today's space program. And for the spending on a new, even technically irreproachable system to be justified, painstaking economic analysis is needed. For now, the cost of developing MAKS, with Mriya already built, is estimated at R2 billion in 1991 prices. But spending on global projects in our country has a habit of growing incredibly.

ESA Seeks Cooperation With Russia on Manned Spaceflight, Space Station

927Q0233 Moscow IZVESTIYA in Russian 15 Sep 92 Morning Edition p 4

[Article by Yuriy Kovalenko, filed in Paris: "Financial Problems Are Forcing Europe to Turn to Russia for Help in Exploring Space"; first paragraph is source introduction]

[Text] **Experiencing an acute shortage of funds, rich Europe is forced to revise its plans to create its own aerospace plane and to independently put a human into near-Earth orbit. Based on new budgetary realities, the director of the European Space Agency (ESA), Jean-Marie Luton, has announced that the agency intends to develop cooperation with Russia in the creation of a system for performing such flights.**

Jean-Marie Luton proposes beginning without delay the creation with Moscow of a Russo-European space system. ESA is ready to participate in the preparations for the new Mir-2 orbital station, which is expected to launch in 1996. Then ESA, in the words of its director, could create with Russia a new Hermes reusable aerospace plane and an orbital station that, in turn, would replace Mir-2 at the beginning of the next century.

The newspaper MONDE regards that proposal of the ESA director as "bold." Even if no one doubts that Russia is the leader in some areas of the exploration of space, writes the newspaper, it is still hard, in implementing such a program, to work with a country in which the currency is not stable, financial capabilities are limited, and the administrative structures have yet to be determined.

ESA, whose members number 13 states, decided to enter into that cooperation with Russia for reasons other than that things are going well. Experiencing considerable budgetary difficulties, the agency has been forced to agree to considerable financial cuts in its own program, cuts that amount to 4.9 billion francs [Fr]. Those cuts do not affect the new Ariane 5 launcher or the development of telecommunications. Just the opposite, the budgetary ax is threatening very seriously the project involving the reusable Hermes aerospace plane and the Columbus orbital laboratory. And that's where the Europeans are increasingly counting on Russia's help.

Several months ago, ESA had already concluded agreements with our scientific research institutes and enterprises. But now, according to MONDE, the agreement involves large-scale contracts for a total of roughly Fr700 million.

All its financial difficulties notwithstanding, ESA does not intend to discontinue the program for manned spaceflight. For that, the Europeans are counting on performing three missions aboard the Mir station.

The final decision on the cooperation between Europe and Russia in space will be made at a minister-level meeting, which will take place in early November 1992, in the Spanish city of Granada.

Satellite Communications Systems Seen As Area For Ukrainian-German Cooperation

LD2110102192 Moscow ITAR-TASS in English 1802 GMT 20 Oct 92

[By UKRINFORM correspondents Sergey Balykov, Anatoliy Grigoryev—TASS]

[Text] Kiev October 20 TASS—Residents of Kiev will be able to contact by telephone their friends in European countries and the U.S. speedily and without problems as early as next month. This opportunity will be accorded to them by an international automatic telephone exchange, the first facility of this kind in Ukraine. The exchange was built jointly by Ukrainian and German communications specialists.

Prospects for further cooperation were reflected in a protocol signed by the Ukrainian Communications Ministry and Germany's Federal Ministry of Post and Telecommunications. The protocol has been the result of negotiations with the German delegation headed by Federal Minister Christian Schwarz-Schilling.

The guest was received by Ukrainian President Leonid Kravchuk today. He spoke highly of the talks between Ukrainian and German communications engineers.

At a press conference held in the Ukrainian Communications Ministry, Schwarz-Schilling emphasised that Germany is interested in the development of infrastructure in Ukraine, in its integration into the European communications system. Germans who live in Kazakhstan, Siberia and Ukraine as well as Ukrainians residing beyond the boundaries of their state sorely need information and communications systems, he observed.

"Telephone communications between various regions of the CIS, TV and radio programmes for them can be organised via a satellite system. To create it is within our powers: Ukraine has sophisticated booster rockets, Germany—satellites and Kazakhstan—the cosmodrome. The more partners are involved in the creation of such a system, the less it will cost. This is one more argument to support the statement that cooperation between Ukraine and Germany is mutually advantageous and it should be developed, Schwarz-Schilling said.

State Support for Space Industry Sought

927Q0225A Moscow ROSSIYSKAYA GAZETA in Russian 4 Sep 92 p 2

[Open letter to the Supreme Soviet and the Russian Federation Government from the workforce of the Chemical Engineering Research and Design Institute: "A Little Further, and the Road to Space Will Be Closed"]

[Text] Cosmonautics is an indisputable and shining priority of Russia and a fundamental reference point for the future capable of uniting not only inhabitants of Russia.

Any sober-minded specialist will understand that so majestic an undertaking cannot under the conditions of a transitional economy be based only on a commercial foundation—it is temporarily in need of state regulation and prudent support. It may be said without exaggeration that either the state involves itself in this most forward-looking sector or it will remain forever a costly burden.

It is perfectly clear to us who see the situation from the inside that both the edict of the president and the ordinance of the government on the Russian Space Agency merely hint at this problem, but do not decide many things in point of substance. Now, when we are being visited by numerous foreign delegations and when we see their astonishment at the immensity and the neglect of what has been created, the time has come to tell you and all our compatriots the truth about the calamitous state of the sector.

This may be shown in the example of our experimental institute, which was formed on the initiative of S.P. Korolev and which has conducted the ground optimization of practically all national carrier rockets and spacecraft. Owing to the lack of money, a unique complex of testing installations with its own space simulators, cryogenic plants, and environmental-protection agents, the value of which constitutes billions of dollars (it is now impossible to count in rubles), is falling apart. Because of the inefficiency of the space programs and, consequently, the wholesale cutbacks in R&D and the minimum wages, we are losing the most capable part of our specialists. One year more, and there will be no one to whom to pass on the invaluable testing experience and no one to conduct serious ground testing.

The situation of other research institutes and design bureaus of a space profile, which is being intensified by their disintegration, which has commenced, is similar. Commercialization, which is penetrating the elite structures, is corroding the mechanism of the creation of rocket and space technology fine-tuned over decades and creating a real threat of the sell-off of the most valuable of our achievements.

Let us lag behind the West "forever," as the joke now goes, in information science, agriculture, and light industry. These technologies may be purchased or assimilated—Russia has talent to spare. But it is unrealistic creating or purchasing and assimilating newly independent Russian cosmonautics. This would mean enormous expenditure without any returns for decades under the conditions of a ruthless race for the space Klondike. This is indicated by the first attempts at our cooperation with Australia and India in the sphere of commercial space, which encountered the resistance of certain forces.

The state has expended on cosmonautics hundreds of billions of dollars and made full use of the labor of enthusiasts of the 1950's-1970's. We cannot allow all this to perish, and Russia, having survived the difficult times, to begin everything all over again.

We propose, therefore:

First, an acceleration of the examination of a space profile with participation of enterprises and enactment in the Supreme Soviet of the law of the Russian Federation "Space Activity."

Second, the adoption of priority rescue measures, in which category may be put:

the government's active search and support for orders for the sector in respect to commercial overseas projects;

the organization of a space association in conjunction with wealthy countries or those which have embarked on the path of the conquest of space of Asia, Latin America, and the CIS;

the full-scale centralization of the regulation of space activity under the aegis of the Russian Space Agency;

optimization of the functions and rights of the Russian Space Agency and separation from the giants of space industry of the state scientific and test centers, design bureaus, and works without which the long-term development of cosmonautics is impossible, and the transfer of these formations to long-term contract relations with the Russian Space Agency;

allocation of resources for the development of unique facilities of space science and technology and basic R&D;

a temporary reduction in profits tax and value-added tax, currency privileges in respect to space products and services and compensation for taxes on land and resources;

the allocation of long-term interest-free credit for Russian commercial projects and the introduction of S&T and production engineering achievements of rocket and space technology in programs for the modernization of power engineering, transport, the agro-industrial complex, and the extractive sectors of Russia and of the creation of joint works;

the privatization of civil and auxiliary works with the workforce being granted additional privileges;

the urgent transfer of previously closed communities to the jurisdiction of local soviets in accordance with Directive 1328-R of the Russian Federation Government of 17 July 1992.

Third, the organization of an all-Russia conference of space enterprises with the participation of the Russian Space Agency, the Ministry of Industry, the Ministry of Defense and other interested ministries, the Russian Academy of Sciences, and commissions of the Supreme Soviet for clarification of the situation and the formulation and concordance of the necessary set of measures.

Fourth, discussion at the level of the governments of Russia, Ukraine, and Kazakhstan and the command of the CIS Joint Armed Forces of all aspects of realization of the joint space programs and corresponding long-term agreements.

We request of people's deputies and members of the government that they do everything possible to ensure that the International Year of the Conquest of Space be a year for the revival of the cosmonautics of Tsiolkovskiy,

Korolev, and Gagarin and the thousands of its anonymous creators.

[Signed] **A. Makarov, director**

R. Palazyan, chairman of the Workforce Council

The letter was supported by:

The Energiya Science-Production Combine, the Mechanical Engineering Central Research Institute, the Design-Engineering Institute of Machine Building for Power Engineering Science-Production Combine, the Chemical Industry Automation Design Bureau, the Measuring Equipment Science-Production Combine, the Mechanical Engineering Research Institute, the Energiya Science-Production Combine VF [expansion not identified], the Design-Engineering Institute of Machine Building for Power Engineering Design Bureau KF [expansion not identified], the Design-Engineering Institute of Machine Building for Power Engineering Design Bureau PF [expansion not identified].

Space Industry Prospects Considered

PM2110143792 Moscow PRAVDA in Russian 17 Oct 92 p 2

[Article by Anatoliy Pokrovskiy: "Controversial Topics. Orbit of Cosmonautics"]

[Text] The welding of the first seam of the international communications center ground station on the territory of the VVTs lit up the fall day like a small firework—and the celebration was over. And celebration it was. A celebration of cosmonautics' commercial awakening. It continues in March 1993, when the American company AT&T and our Teleport-TP joint-stock company will be able to provide the first thousands of subscribers with international telecommunication services.

Good? You bet! B. Antonyuk , chairman of the Teleport-TP board, is proud for a reason:

"This project will assist the development of the telecommunications infrastructure in Russia, in particular promoting investments in Russia and the CIS countries by representatives of foreign business circles."

But the final sentence of the press release is perplexing: "The Teleport-TP ground station has been registered at Intelsat, the international satellite communications organization located in Washington (United States), as an international operator of the Intelsat satellite network." Translated, this means that it was not out of the goodness of their hearts that the Americans concluded a $10 million contract with us and supplied us with equipment for the station. In exchange, we get involved in servicing and maintaining U.S. communications satellites.

No, far be it from me to reproach the transatlantic partners. They are business people and they operate in a businesslike fashion. And the space communications system is one of the most profitable sectors of cosmonautics. The vexing thing is—where is our global communications system? After all, we do have Molniya, Gorizont, and Ekran satellites, and our communications satellites are functioning reliably as part of the KOSPAS-Sarsat international emergency system. There are also global communications projects, but they have gotten bogged down in endless debates about which is the best and in the quest for funds for their implementation. At the moment, only two "Gonets"-type devices are operating out of the 36 low-orbit satellites that are supposed to provide our global communications.

Indeed cosmonautics can provide appreciable dividends aside from communications. Our estimates, as ever, are unknown, although, according to French data, it costs $250 million to launch a satellite using an Ariane rocket. Except that we have never launched a single satellite for that amount. The laws of the market are tough—high technology competitors are not very popular. They will go to any lengths, including the notorious COCOM [Coordinating Committee on Export Controls] bans on supplying our country with items of advanced technology. So you could not even bring a carefully sealed Western satellite to our space center.

The bans are still in place, although our president and government head never tire of pledging friendship with the West. The market has its own ethos, and it is in no hurry to slacken the COCOM reins.

Let us analyze from this viewpoint the latest international agreements concluded by the newfangled Russian Space Agency. The first joint effort with the Americans since the Soyuz-Apollo flight was the placing of a U.S. instrument to study the earth's ozone layer on board our Meteor-3. A U.S. astronaut is to work on the Mir station, and in 1995 Mir is to dock with the space shuttle. Our space station (remember it is still the only one in the world) may also be visited by French astronauts. Collaboration with the Americans in the study of Mars is also planned.

These are probably all the biggest international projects. You do not have to be a specialist to see that they will not bring us major dividends. And given our poverty at home it is difficult to imagine cosmonautics benefiting our national economy. And although annual appropriations for it are increasing by 60 percent on average, Russian Space Agency General Director Yu. Koptev can only provide a very vague list of the possible areas of activity: communications organization, again, plus ecological and meteorological monitoring, study of natural resources, and space technology.

Not a lot. But perhaps one should not blame overseas competitors for everything. The new agency, although it has removed the Ministry of General Machine Building sign from its door, remains maladroit and tame in its commercial publicity efforts. Moreover, the now autonomous Main Space Administration and the individual space firms gathering international momentum are adopting an aggressive posture in the market, beating down one another's project prices.

To be fair, we are not the only ones experiencing cosmonautics conversion problems. But not for nothing did the

United Nations end the international conference "Swords into Plowshares: Development in a Changing World," mainly concerned with the conversion of aerospace sectors, in Moscow yesterday. And not for nothing did Vice Premier G. Khizha mention for the first time in public, during the conference, the stubborn opposition to our high technology products coming onto the world market.

The planned "Europe-America" space flight, commemorating the 500th anniversary of the New World and International Space Year, which already has extensive support, stands out against this bleak background. The proposal by the Social Inventions Foundation, the Samara TsSKB [Central Specialized Design Bureau], and a number of other establishments is very interesting. On 16 November, a Resurs-500 satellite will be launched from the Russian Plesetsk space center. The reentry vehicle will carry messages from the leaders of Russia and the EC, public associations, and international organizations to the peoples of America, descriptions of projects with a social orientation, examples of products, and publicity and other materials from the participating firms. The reentry vehicle will splash down off the west coast of the United States and will be taken to Seattle on Thanksgiving Day by our naval ship Marshal Krylov.

This space project, to be implemented for the first time not by a state, but by public organizations and commercial structures, has already aroused great interest in America. Here, for example, is what Mayor Norman B. Rice of Seattle wrote B.N. Yeltsin: "I hope this remarkable plan becomes a reality. The world has entered a new era, which makes it possible to replace military confrontation with economic cooperation and place the military industry on a civil footing. The 'Europe-America Space Flight-500' project is a timely act, to draw attention to these peaceful goals."

And, I would add, to the potential of our cosmonautics. So it will ignite new ideas for mutually advantageous collaboration in formerly secret areas of high technology. This is what is needed in present conditions to resolve the controversies that are distorting the orbits of the most advanced sector of our science and technology.

Spacecraft Control Center Network Explained

934C0144A Moscow ARGUMENTY I FAKTY in Russian No 41, Oct 92 p 4

[Reader's letter and ARGUMENTY I FAKTY correspondent's response: "Lieutenant 'Golitsyno' Is on the Air"]

[Text] *I heard from an acquaintance that somewhere in the Moscow area there is a top secret space center compared to which the well-known spaceflight control center is simply a 'kindergarten.' What do you know about this?*

[Signed] A. Zakrzhevskiy, Bugulma

Our correspondent A. Sargin visited the Main Testing and Control Center for the "Golitsyno-2" space vehicles and this is what he managed to find out.

All space vehicles launched in the country are controlled and tracked using the network of individual command-and-measuring complexes (OKIK) within the structure of this center. A total of 190 operating space vehicles are now in orbit. Each day up to 1,000 communications sessions are held with 100 to 110 of them. Command-and-measuring complexes are located on the territory of the former Union (10 in Russia, three in Ukraine, and one each in Kazakhstan and Uzbekistan).

It is through the command-and-measuring complexes that the government's satellite communications operate. But of the leaders of the republics of the former USSR only Yeltsin and Nazarbayev are full-fledged operators, that is, can make use of them both within the country and abroad. But Kravchuk has access only to intrarepublic communications.

"Golitsyno-2" also controls satellites used to transmit programs for Central Television and Russian Television. An officer from one of the command-and-measuring complexes told us that once during the period of stagnation a single soldier inadvertently brushed against a rack and the whole of Moldova was for a time deprived of Central Television.

Military Commanders of Russian Space Forces Named

PM1210135192 Moscow KRASNAYA ZVEZDA in Russian 10 Oct 92 p 3

[Russian Defense Ministry Press Service report: "Appointments"]

[Text] By order of the Russian defense minister, Colonel General Vladimir Leontyevich Ivanov has been appointed commander of the Russian Defense Ministry Military-Space [voyenno-kozmicheskiye] Forces. Lieutenant General Stanislav Nikolayevich Yermak has been appointed chief of staff and first deputy commander. Major Generals Nikolay Andreyevich Borisyuk, Yuriy Grigoryevich Gusev, and Leonid Denisovich Kizim have been appointed deputy commanders.

Gaydar Approves Use of Dismantled Missiles for Commercial Launches

LD2710140292 Moscow ITAR-TASS in English 1239 GMT 27 Oct 92

[By ITAR-TASS correspondent Ivan Ivanov]

[Text] Moscow October 27 TASS—Acting Prime Minister of Russia Yegor Gaydar has signed an injunction "on the rational use for economic purposes of missile complexes that are to be dismantled in light of the ongoing reduction and restriction of strategic offensive weapons."

The document, obtained by ITAR-TASS, approves the proposal to use missile complexes (without nuclear charges), after their modification, for commercial launchings of space vehicles on orders from Russian and foreign firms. The launching installations and missiles, which are not slated for such purposes, will be taken apart and their systems, parts and materials will be used in the national economy or exported. The territories of the launching complexes will be used to set up private farms and to build housing for officers of the Russian Armed Forces.

The injunction also approves the proposal of corresponding Russian ministries and departments to take part in the implementation of the project of the association of business cooperation with foreign states "scientific-technical progress," the "conversion of submarine ballistic missiles" association, and the "joint stock union for conversion" and "by-products and space industry" joint-stock society.

'Star of Columbus' Satellite to Land Capsule Off U.S. Coast

927Q0236 Moscow KRASNAYA ZVEZDA in Russian 24 Sep 92 p 4

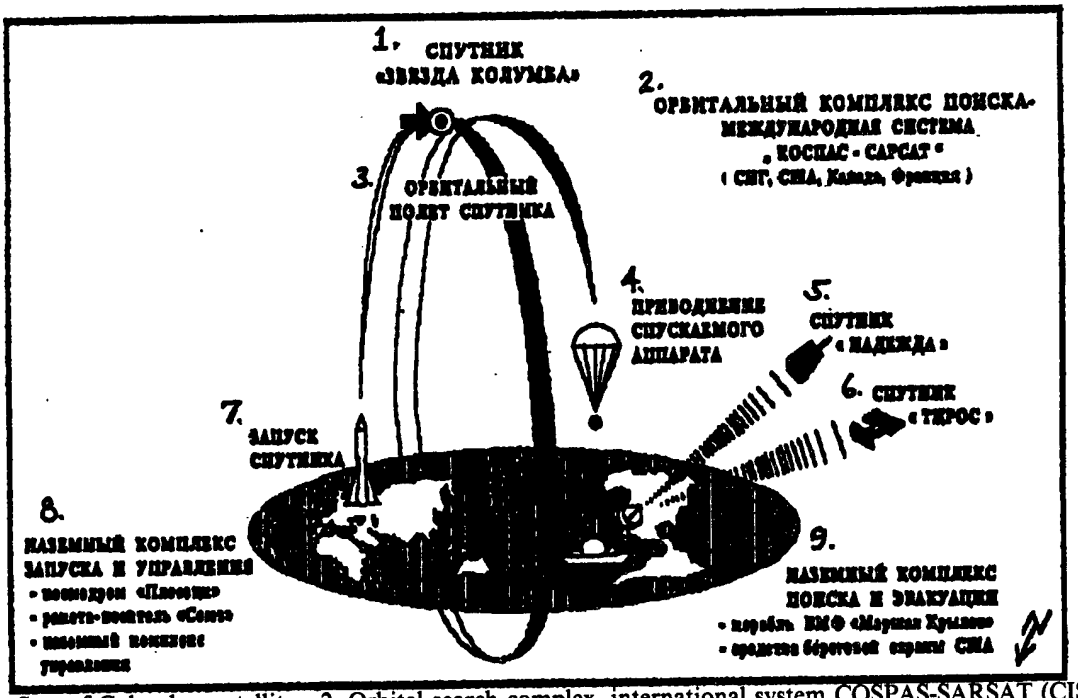
[Article by M. Rebrov: "250 Million...For the Discovery of America?: Some Subjective Judgments About a Certain International Space Project"]

[Text] At a recent press conference on space and commerce, a colleague sitting next to me was skeptical: "It's hard for me to imagine that any of our new-found millionaires would want to buy a rocket or a satellite." But he didn't turn out to be a prophet. Takers were found. And they bought, laying out 250 million for their purchase. The seller and the buyer, as is supposed to happen, were courteous to each other. For that sum of money, the Central Specialized Design Bureau and Plant Progress (city of Samara) presented the "customer" a rocket, a spacecraft, and a return module. The space units of the Russian Ministry of Defense, also for money, I think, have undertaken to perform the launch and to control the flight.

I can see the impatience of the readers to find out the name of the buyer and the future fate of the "buy of the century." Let me explain—it's not a physical person. The millions were laid out by the Foundation for Social Innovations, the Garant firm, the Sankt-Peterburg Bank, the Innovatsiya [Innovations] firm, and the Center for International Business Projects. And there are other participants in the deal. As for the aim of the purchase, it is as follows: to discover America in terms of new business contacts and to mark, along with the Americans, their national holiday—Thanksgiving Day—in this glorious, round year of the 500th anniversary of Columbus's discovery of the New World.

The planned event has received a big name: "Space Flight Europe- America 500." By the way, the satellite we're talking about has the designation "500," following the word "Resurs" (a second name for it is the "Star of Columbus"). The profile of the project is unsophisticated, if not simple.

On 16 November 1992 (the alternate date is 17 November), a Soyuz launcher will lift off from the Plesetsk Cosmodrome. It will place the above-mentioned satellite into orbit (see the diagram). Five days later, a half-ton return module will separate from the satellite and splash down in the ocean not far from the American port city of



Key: 1. Star of Columbus satellite—2. Orbital search complex, international system COSPAS-SARSAT (CIS, U.S., Canada, France)—3. Orbital flight of satellite—4. Splashdown of return capsule—5. Hope satellite—6. TIROS satellite—7. Launch of satellite—8. Ground complex for launch and control (Plesetsk Cosmodrome, Soyuz launch vehicle, ground control complex)—9. Ground complex for search and evacuation (Marshal Krylov naval vessel, U.S. Coast Guard systems)

Seattle. The international search-and-rescue COSPAS-SARSAT satellite system will identify the precise splashdown point. The space cargo is then to be taken aboard the Marshal Krylov tracking ship. In the search for the return capsule, the U.S. Coast Guard will help the crew of our vessel. That, in fact, is it.

Wishing to give their idea a great deal of import, the organizers said at the press conference and have said in the press that their event is coordinated with the International Space Year and the UN conference on conversion, that the project is unique, and that in Seattle the program is being handled by Robert Walsh, the famous master of ceremonies and shows. To all that can be added one more assertion of the organizers: the project is not commercial, but profoundly humanitarian, and the idea of a space bridge between Europe and America is but a "symbol of a constant journey."

Enough, say the skeptics. Why so much celebration and exclamation when America is already discovered? Yes, bridges have already been put up between Russia and America. In that memorable year of 1937, when record-breaking flights were made aboard the illustrious ANT-25 along the route of Moscow to the North Pole to the United States. In 1975, when the Soyuz-Apollo mission was performed, and much later, when "television bridges" appeared, and then the so- called friendship bridges.

As for the words "commercial" and "noncommercial," we need to define our terms. Is it not an argument in favor of the latter term that the Samara builders of space hardware, as a representative of the Central Specialized Design Bureau asserts, will not make any kind of profit at all? You say they have already gotten plenty after filling the order? That's caviling. What about the sale of the "weights" and "volumes" in the return capsule? Not convincing. Everybody has the right to resell what's bought today.

I see also this question: "Who can buy it and for how much?" My answer: anybody. And if to some the prices seem astronomical, then don't forget that the project is a space project. And space has always been the magic of big numbers. And is it really expensive when a kilogram of good smoked sausage costs almost a thousand rubles [R], and we pay for a kilogram of "space cargo" a million (if you figure in dollars, $30,000)? If you prefer to do the accounting in units of volume, then by all means. For 0.01 cubic meter, they'll take from you R3,800,000 ($115,000). Aboard the satellite will be 19 containers. The total volume of a container is 0.06 cubic meter and is valued at R23 million, or $600,000. So if you agree with the film version that the "rich also cry" and you don't have such means, draw your firm's logo on the rocket. One square meter will cost us $40,000-50,000. A sign at the launch pad costs $10,000-20,000.

Everything that is loaded in the containers can be sold at the final destination for hard currency. And that's not commerce at all, but profoundly "humanitarian." At any rate, that's how the project is being advertised.

Five-hundred (there's that number again) of our countrymen will make the trip to Seattle by air or sea. And that is also totally justified, because "businessmen need business contacts," and the project is international.

What's unique about it? On the technical end of it, the Soyuz launch vehicle is series-produced, and such vehicles have been launched some 1,500 times. The return capsule, although nothing new to us (870 Foton-type return capsules have been returned to the ground after their work in orbit), demonstrates a high degree of reliability. And there's no doubt whatsoever that our "package" will splashdown right on target.

You feel sort of awkward, offended, ashamed? Dash those feelings right away. And don't be troubled by the fact that during the preparations for the flight, "there was very little activity on the part of representatives of the U.S. military-industrial complex." They're not paying for the project, we are. But the discussion has clearly drawn out too long. Anyway, as we're used to hearing, "the matter is done with already."

And don't be skeptical. Our space program still remains our national pride. After growing some talented designers and specialists with the greatest of skills, after inventing many truly unique technologies, after creating the most complex hardware of the century, our space program is going through what are not its best times. Of course, though, help comes in different forms, but what can be done? The philanthropist-sponsors have a right to what is theirs. And the fact that one of our space firms in the context of conversion has begun to stitch men's underwear—well, those are the times. They will answer the question, Can we explore space if we're sewing shorts?

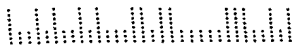
Some brief facts:

The **Soyuz launch vehicle** is a multipurpose, three-stage vehicle designed for lifting manned and unmanned spacecraft into near-Earth orbits. The rocket, with fairing, is 39.3 meters long and 10.3 meters wide at its widest point and can lift a payload of as much as 7,000 kg.

The **Resurs space system** is designed for rapid collection of information on the states of land surfaces, the ocean, and the environment and for photographing the Earth's surface with a high spatial resolution. "The economic impact from the use of the orbital images in such sectors as geology, agriculture, water management, forest management, and fishing will, in the near future, amount to nearly R1 billion a year" (from the advertising booklet of Glavkosmos, "Space and Commerce"). The return capsule is a sphere 2.3 meters in diameter.

The **floating tracking complex** Marshal Krylov has a draft of 24,000 tons. It is 210 meters long and 27 meters wide, travels at up to 22 knots, can stay out for up to four months, and can traverse 20,000 miles on the fuel reserves on board. It has advanced electronic equipment and carries two helicopters.

That's how things are.



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